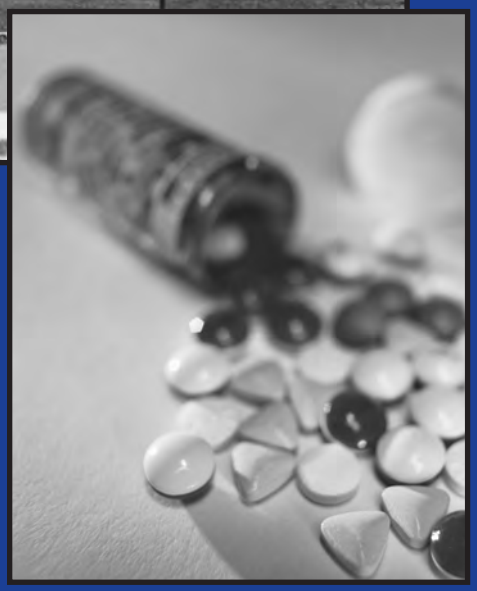
EPA United States Environmental Protection Agency

Healthcare Environmental Assistance Resources

Pollution Prevention and Compliance Assistance for Healthcare Facilities

Profile of the Healthcare Industry

EPA Office of Compliance Sector Notebook Project



SECTOR EPA 34 NOTEBOOKS

EPA/310-R-05-002

EPA Office of Compliance Sector Notebook Project

Profile of the Healthcare Industry

February 2005

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (MC 2224-A)
Washington, D.C. 20460

Cover photo courtesy of Dartmouth-Hitchcock Medical Center

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Eastern Research Group, Inc. (ERG) (Lexington, MA), Abt Associates (Cambridge, MA), GeoLogics Corporation (Alexandria, VA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). A listing of available Sector Notebooks is included on the following page.

The Notebook will orient readers from a wide audience to the environmental responsibilities and challenges facing health service providers including major medical centers, ambulatory healthcare clinics, dental offices, doctors offices and veterinary clinics. The Notebook will be especially useful in educating those in industry as well as government and the general public who are unfamiliar with the complex environmental regulations that apply to the healthcare industry. With references for more detailed information, the Notebook will nicely complement new resources on compliance, environmental management systems, pollution prevention, and the nascent on-line healthcare environmental resource center.

Obtaining copies:

Electronic versions of all Sector Notebooks are available on EPA's web site at *www.epa.gov/compliance/sectornotebooks.html*.

A limited number of **complimentary volumes** are available to certain groups or subscribers, including public and academic libraries; federal, state, tribal, and local governments; and the media. You can order from EPA's National Service Center for Environmental Publications at **(800) 490-9198** or *www.epa.gov/ncepihom*. When ordering, use the applicable EPA publication number from those listed on the following page.

The Sector Notebooks were developed by the EPA's Office of Compliance. Direct general questions about the Sector Notebook Project to:

Coordinator, Sector Notebook Project
U.S. EPA Office of Compliance
1200 Pennsylvania Ave., NW (2224-A)
Washington, D.C. 20460
(202) 564-2310

AVAILABLE SECTOR NOTEBOOKS

Questions and comments regarding the individual documents should be directed to Compliance Assistance and Sector Programs Division at (202) 564-2310 unless otherwise noted below. **See the Notebook web page at: *www.epa.gov/compliance/sectornotebooks.html* for the most recent titles and links to refreshed data.**

EPA Publication Number	Industry
EPA/310-R-95-001.	Profile of the Dry Cleaning Industry
EPA/310-R-95-002.	Profile of the Electronics and Computer Industry*
EPA/310-R-95-003.	Profile of the Wood Furniture and Fixtures Industry
EPA/310-R-95-004.	Profile of the Inorganic Chemical Industry*
EPA/310-R-95-005.	Profile of the Iron and Steel Industry
EPA/310-R-95-006.	Profile of the Lumber and Wood Products Industry
EPA/310-R-95-007.	Profile of the Fabricated Metal Products Industry*
EPA/310-R-95-008.	Profile of the Metal Mining Industry
EPA/310-R-95-009.	Profile of the Motor Vehicle Assembly Industry
EPA/310-R-95-010.	Profile of the Nonferrous Metals Industry
EPA/310-R-95-011.	Profile of the Non-Fuel, Non-Metal Mining Industry
EPA/310-R-02-001.	Profile of the Organic Chemical Industry, 2nd Edition*
EPA/310-R-95-013.	Profile of the Petroleum Refining Industry
EPA/310-R-95-014.	Profile of the Printing Industry
EPA/310-R-02-002.	Profile of the Pulp and Paper Industry, 2nd Edition
EPA/310-R-95-017.	Profile of the Stone, Clay, Glass, and Concrete Industry
EPA/310-R-95-018.	Profile of the Transportation Equipment Cleaning Industry
EPA/310-R-97-001.	Profile of the Air Transportation Industry
EPA/310-R-97-002.	Profile of the Ground Transportation Industry
EPA/310-R-97-003.	Profile of the Water Transportation Industry
EPA/310-R-97-004.	Profile of the Metal Casting Industry
EPA/310-R-97-005.	Profile of the Pharmaceuticals Industry
EPA/310-R-97-006.	Profile of the Plastic Resin and Man-made Fiber Industry
EPA/310-R-97-007.	Profile of the Fossil Fuel Electric Power Generation Industry
EPA/310-R-97-008.	Profile of the Shipbuilding and Repair Industry
EPA/310-R-97-009.	Profile of the Textile Industry
EPA/310-R-98-001.	Profile of the Aerospace Industry
EPA/310-R-00-001.	Profile of the Agricultural Crop Production Industry Contact: Ag Center, (888) 663-2155
EPA/310-R-00-002.	Profile of the Agricultural Livestock Production Industry Contact: Ag Center, (888) 663-2155
EPA/310-R-00-003.	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry Contact: Agriculture Division, (202) 564-2320
EPA/310-R-00-004.	Profile of the Oil and Gas Extraction Industry
EPA/310-R-05-002.	Profile of the Healthcare Industry
EPA/310-R-05-003.	Profile of the Rubber and Plastic Industry, 2nd Edition
	Government Series
EPA/310-R-99-001.	Profile of Local Government Operations
EPA/300-B-96-003.	Profile of Federal Facilities
EPA/310-R-05-001.	Profile of Tribal Government Operations

* Spanish translations of 1st Editions available in electronic format only.

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Healthcare Industry - Including Hospitals, Physicians Offices, Dental Offices, Nursing Homes, etc. (NAICS 62)

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LIST OF ACRONYMS

ADA	American Dental Association
AFS	Air Facility Subsystem
AHA	American Hospital Association
AHCA	American Health Care Association
AHERA	Asbestos Hazard Emergency Response Act
AIRS	Air Facility Indexing and Retrieval System
AMA	American Medical Association
ANA	American Nurses Association
ANSI	American National Standards Institute
ASHE	American Society for Healthcare Engineers
ASHES	American Society for Healthcare Environmental Services
AST	Aboveground Storage Tanks
AVMA	American Veterinary Medical Association
BBP	Blood Borne Pathogens
BIF	Boilers and Industrial Furnaces
BOD	Biochemical Oxygen Demand
BRS	Biennial Reporting System
C&D	Construction and Demolition
CAA	Clean Air Act
CAM	Compliance Assurance Monitoring
CAP	College of American Pathologists
Cd	Cadmium
CDC	Centers for Disease Control
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act
CERCLIS	Comprehensive Environmental and Liability Information System
CESQG	Conditionally Exempt Small Quantity Generator
CFC	Chlorofluorocarbon
CFR	Code of Federal Register
CMS	Centers for Medicare and Medicaid Services
CSRD	Central Sterile Reprocessing and Distribution
CWA	Clean Water Act
DMR	Discharge Monitoring Reports
DOT	Department of Transportation
e-CFR	Electronic Code of Federal Regulations
ECHO	Enforcement and Compliance History Online
ECOS	Environmental Council of the States
EEG	Electroencephalograph
EMS	Environmental Management System
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPP	Environmentally Preferable Purchasing
EtO	Ethylene Oxide
FDA	Food and Drug Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act

FQPA	Food Quality Protection Act
FRN	Federal Register Notice
FRS	Facility Registry Systems
GDP	Gross Domestic Product
H2E	Hospitals for a Healthy Environment
Hal	Hydrochloric Acid
HAP	Hazardous Air Pollutants
HAZWOPER	Hazardous Waste Operations and Emergency Response
HBN	Healthy Building Network
HCWH	Health Care Without Harm
Hg	Mercury
HHS	Health and Human Services
HMIWI	Hospital/Medical/Infectious Waste Incinerators
HVAC	Heating Ventilation and Air Conditioning
ICIS	Integrated Compliance Information System
IDEA	Integrated Data for Enforcement Analysis
IS	Information Services
ISO	International Organization for Standardization
JCAHO	Joint Commission on Accreditation of Healthcare Organizations
LDR	Land Disposal Restrictions
LEPC	Local Emergency Planning Committees
LQG	Large Quantity Generators
MACT	Maximum Achievable Control Technology
MCL	Maximum Containment Levels
MCLG	Maximum Containment Level Goals
MMS	Minerals Management Service
MOU	Memorandum of Understanding
MRI	Magnetic Resonance Imaging
MS4	Municipal Separate Storm Sewer Systems
MSDS	Material Safety Data Sheet
MSW	Municipal Solid Waste
MWTA	Medical Waste Tracking Act
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NCDB	National Compliance Database
NEETF	National Environmental Education & Training Foundation
NESHAP	National Emission Standards for Hazardous Air Pollutants
NET	National Emission Trends
NIHE	National Institute for Health and the Environment
NLIC	National Lead Information Center
NOVs	Notices of Violation
NO_x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NPIC	National Pesticide Information Center
NRC	Nuclear Regulatory Commission
NSPS	New Source Performance Standards

NSR	New Source Review
NTI	National Toxics Inventory
OAR	Office of Air and Radiation
OB/GYN	Obstetrics and Gynecology
OECA	Office of Enforcement and Compliance Assurance
OSHA	Occupational Health and Safety Administration
OSWER	Office of Solid Waste and Emergency Response
P2	Pollution Prevention
P2OSH	Pollution Prevention and Occupational Safety and Health
Pb	Lead
PCB	Polychlorinated Biphenyls
PCS	Permit Compliance System
PEER	Public Entity Environmental Resource Center
POTW	Publicly Owned Treatment Works
PSD	Prevention of Significant Deterioration
PVC	Polyvinyl Chloride
RCC	Resource Conservation Challenge
RCRA	Resource Conservation and Recovery Act
RCRAInfo	Resource Conservation and Recovery Act Information System
RMW	Regulated Medical Waste
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SERC	State Emergency Response Commissions
SHP	Sustainable Hospitals Project
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SPCC	Spill Prevention Control & Countermeasure
SQG	Small Quantity Generators
SWDA	Solid Waste Disposal Act
TCLP	Toxicity Characteristic Leaching Procedure
TIP	Tribal Implementation Plans
TRI	Toxic Release Inventory
TRIS	Toxic Release Inventory System
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
UIC	Underground Injection Control
USDW	Underground Sources of Drinking Water
USPS	United States Postal Service
UST	Underground Storage Tanks
VOC	Volatile Organic Compounds

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water, and land pollution (such as economic factors and community-based approaches) are becoming an important supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multistatute solutions to facility permitting, compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving this policy are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these interrelationships by designing policies for the "whole" facility. One way to achieve a whole-facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within EPA's Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common-sense environmental protection measures for specific industries is dependent on knowledge of several interrelated topics. The key topics examined for this project are: general industry information (economic and geographic); a description of activities; pollution outputs; pollution prevention opportunities; federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that you can further explore using references listed at the end of this profile. As a check on the information included, each Notebook went through an external document review process. The Office of Compliance appreciates the efforts of all those who participated in this process and enabled us to develop more complete, accurate, and up-to-date summaries. Many of those who reviewed this Notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this Notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the Notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing Notebook, or if you would like to provide additional information, please send a hard copy and computer disk to EPA Office of Compliance, Sector Notebook Project (2224-A), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Comments can also be sent via the Sector Notebooks web page at: *www.epa.gov/compliance/sectornotebooks.html*. If you are interested in assisting in the development of new Notebooks, or if you have recommendations on which sectors should have a Notebook, please contact the Office of Compliance at (202) 564-2310.

Adapting Notebooks to Particular Needs

This Sector Notebook is meant to generally describe the healthcare industry on a national basis. In many instances, facilities within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state, tribal, and local environmental agencies and other groups to supplement or repackage the information included in this Notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states and tribal governments may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state, tribal, and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail.

Updated Web Site Links

An updated list of all of the web links contained in this Notebook can be found at *www.hercenter.org/links*.

II. INTRODUCTION TO THE HEALTHCARE INDUSTRY

This section provides background information on the size, geographic distribution, employment, and economic condition of the healthcare industry. Facilities described within the document are also described in terms of their North American Industry Classification System (NAICS) codes. The NAICS, which was developed jointly by the United States, Canada, and Mexico to provide new comparability in statistics about business activity across North America, has replaced the U.S. Standard Industrial Classification (SIC) system, under which Health Services is designated 80. Facilities in the healthcare industry are identified under NAICS code 62.

Note that, while there are benefits to the NAICS codes for organizing categories of business, there are disadvantages in the case of the healthcare sector. For the most part, healthcare organizations, whether large or small, in-patient or outpatient, have some level of complexity to their operations and functions. Even small multiservice hospitals have complex service offerings, and generate a large variety of waste. Therefore, the NAICS code information presented below is supplemented with a more robust picture of the rapidly changing healthcare universe.

II.A. Introduction, Background, and Scope of the Notebook

The healthcare and social assistance industry (NAICS code 62) comprises many subsectors including ambulatory healthcare services, hospitals, nursing and residential care facilities, and social assistance. This Notebook focuses primarily on the activities performed at hospitals. However, many of these activities can be performed by others in the healthcare industry, and as such, this notebook applies to those providers as well.

The specific subsectors covered in this industry document are:

- **NAICS 621. Ambulatory Healthcare Services**. The following types of facilities are covered under this NAICS code:
  - Physicians' offices,
  - Dentists' offices,
  - Other health practitioners' offices,
  - Outpatient care centers,
  - Medical and diagnostic laboratories,
  - Home healthcare services, and
  - Other ambulatory healthcare services.

  These entities may be free standing and perhaps privately owned or may be part of a hospital or health system. Currently, most hospitals (NAICS 622) also offer ambulatory healthcare services. For some facilities, these services represent as much as 60-70 percent of hospital business. Much of this change has been driven by adjustments in healthcare finance and reimbursement, advances in technology, and new and effective

pharmaceuticals, which eliminate the need for inpatient and invasive care services.

Also of note is the growing emergence of complementary healthcare services that are also ambulatory in nature. These include chiropractic care, massage, acupuncture, and acupressure.

- **NAICS 622. Hospitals**. The following types of facilities are covered under this NAICS code:
  - General medical and surgical hospitals,
  - Psychiatric and substance abuse hospitals, and
  - Specialty (except psychiatric and substance abuse) hospitals.

  This category potentially includes many types of hospitals such as academic medical center/university-based/teaching hospitals, community hospitals, speciality hospitals (i.e., orthopedic or pediatric), and tertiary care facilities that are qualified to handle major trauma cases (i.e., burns and catastrophic accidents). There are also distinctions between public and private hospitals, hospitals that are part of a healthcare system (i.e., organizations such as Kaiser Permanente), Veterans Administration hospitals, and other types of facilities.

  Hospitals and healthcare systems are continually changing their service offerings, and responding to various internal and external forces including reimbursement issues, advances in technology, and shifts in the populations they serve.

- **NAICS 623. Nursing and Residential Care Facilities**. The following types of facilities are covered under this NAICS code:
  - Nursing care and assisted living facilities,
  - Residential mental retardation/health and substance abuse facilities,
  - Community care facilities for the elderly, and
  - Other residential care facilities.

  Nursing care and residential care facilities offer nonacute care to individuals, either those suffering from a chronic condition (e.g., dementia, developmental delay, multiple sclerosis, Parkinson's disease, autism), aging, or mental health problems.

  As population demographics in the United States shift and demand for care services and facilities increases, more and more facilities offering some component of the above services will arise.

The veterinary services industry (NAICS 541940) also performs many activities similar to the healthcare industry. Veterinary facilities may find some of the information in this Notebook relevant and useful.

- **NAICS 541940. Veterinary Services**. This industry includes establishments of licensed veterinary practitioners primarily in the practice of veterinary medicine, dentistry, or surgery for animals, and establishments providing testing services for licensed veterinary practitioners.

II.B. Characterization of the Healthcare Industry

II.B.1. Service Characterization

The healthcare industry provides a variety of services to support the healthcare needs of a community or individuals. Many of the activities in healthcare result in waste outputs and air or water pollution. In order to understand which activities generate polluting waste outputs, it is necessary to look at various functions within healthcare, and understand the products and supplies used and the resulting wastes. Much of the waste in healthcare is solid waste consisting of paper, cardboard, glass, plastic, and metals. A subcomponent of healthcare waste is biohazardous, or infectious waste. Another component is Resource Conservation and Recovery Act (RCRA) hazardous waste.

Healthcare is vastly different from the many industries that have a defined 'product line,' a finite number of input materials and defined and consistent 'waste outputs.' There are thousands of procedures, tests, processes, and activities, which encompass as many materials. The hazardous component in healthcare waste tends to be made up of small amounts of many different wastes, emanating from many different departments. Due to the decentralized nature of service delivery in healthcare, there can be various departments with different functions all generating various amounts of hazardous waste.

Hospitals are most often described by speciality or service areas. Some of these areas include, but are not limited to: cardiology, critical care, emergency services, family practice, facility engineering, general surgery, gynecology, infectious disease, internal medicine, laboratory and analysis, medical monitoring/computer services, morgue, neurology, neurosurgery, obstetrics, oncology, pathology, pharmacy, radiology, residential care, and urology.

II.B.2. Industry Size and Geographic Distribution

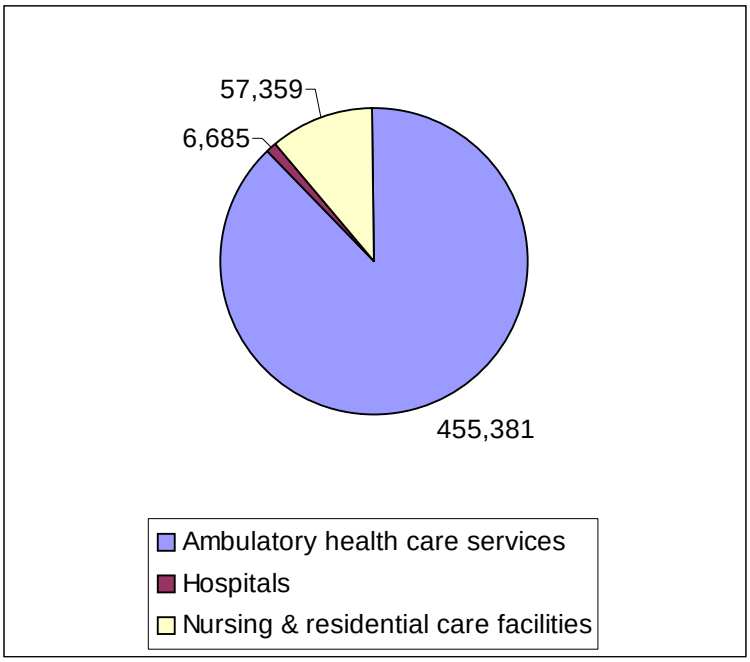
The healthcare industry impacts the lives of nearly every person in the United States. According to the 1997 Census of the Healthcare Industry (NAICS codes 621, 622, and 623), there are more than 500,000 healthcare facilities throughout the country, employing almost

12 million people, with an annual payroll of more than $353 billion. In 2002, the 5,794 registered[1] hospitals included 975,962 staffed beds and admitted 36,325,693 patients.

Hospitals alone contribute more than $1.3 trillion to the nation's economy, according to a TrendWatch report by the Lewin Group released at the 2004 AHA Annual Meeting in Washington. Hospitals employ nearly five million people, rank second as a source of private sector jobs, and directly or indirectly support one of every nine jobs in the United States.

Figure II-1 demonstrates how the healthcare industry is divided among ambulatory healthcare facilities, hospitals, and nursing and residential care facilities. The majority of the facilities, 88 percent, are ambulatory healthcare facilities. The remainder of the industry is divided between nursing and residential care facilities (11 percent) and hospitals (1 percent).

Figure II-1: Number of Establishments in the Healthcare Industry

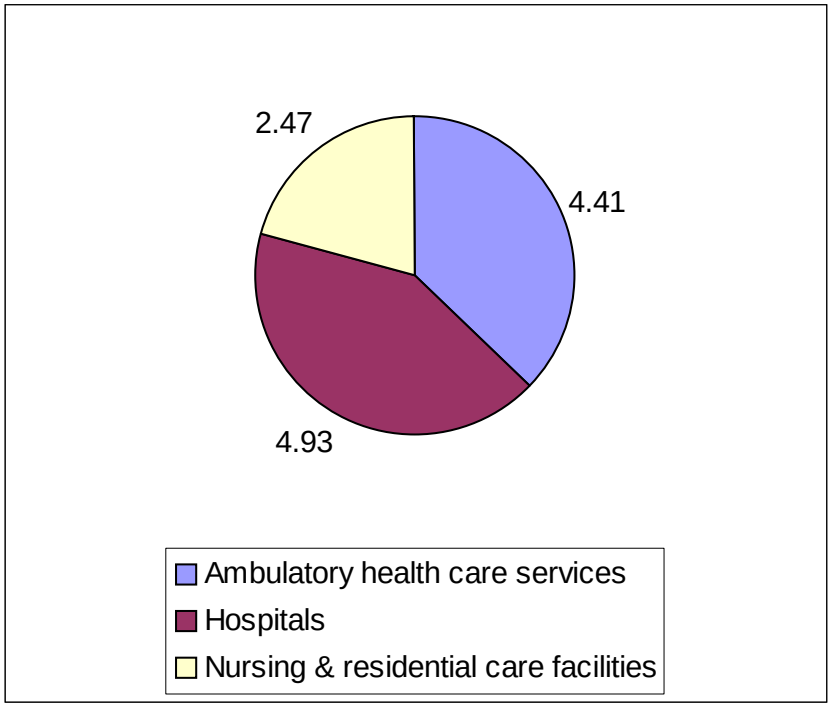


Source: The 1997 Economic Census of the Healthcare and Social Assistance Industry.

Although ambulatory healthcare facilities make up 88 percent of the healthcare facilities, hospitals have the most employees, totaling more than 42 percent of the industry. Ambulatory healthcare facilities have 37 percent of the healthcare staff, while nursing and residential care facilities have only 21 percent. Figure II-2 shows the number of employees by type of healthcare facility.

[1] Registered hospitals are those hospitals that meet the American Hospital Association's (AHA) criteria for registration as a hospital facility. Registered hospitals include AHA member hospitals as well as nonmember hospitals. For a complete list of the criteria used for registration, please see *http://www.hospitalconnect.com/aha/resource_center/*

Figure II-2: Number of Paid Employees (millions) by Type of Healthcare Facility

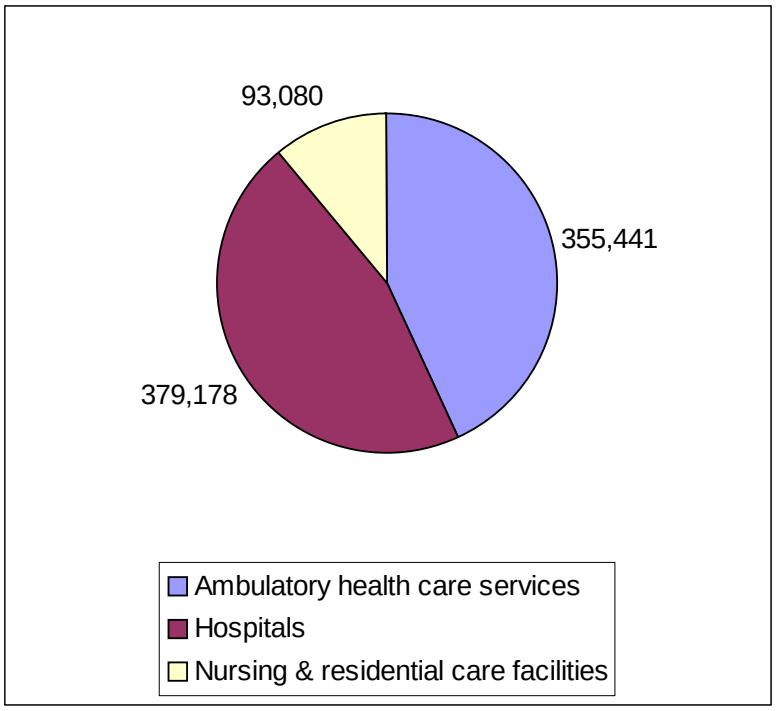


Source: The 1997 Economic Census of the Healthcare and Social Assistance Industry.

The revenue for healthcare facilities is divided unevenly across the number of ambulatory healthcare, hospitals, and nursing and residential care facilities. As shown in Figure II-3, the majority of the revenues, 46 percent, are from hospitals. It is important to once again note, however, that a large part of a hospital's service offerings are ambulatory healthcare offerings. There are also many hospitals/health systems that have affiliated nursing homes, residential care facilities and other healthcare sector entities that deliver service, which may not be reflected in the value of claims and revenues. The remainder is divided between ambulatory healthcare facilities (43 percent) and nursing and residential care facilities (11 percent). In the healthcare industry, these revenues come from:

- Patient care services (which includes laboratory services, diagnostic testing, and direct patient care);
- Home healthcare services, including sales of blood, blood products, organs and tissues, and ambulance services;
- Rental and leasing of goods and equipment, including both medical and "other"; and
- Other services and medical equipment related to prescription and nonprescription drugs, vision care services, orthopedic services, and other related needs.

Figure II-3: Value of Revenue in the Healthcare Industry (millions)



Source: The 1997 Economic Census of the Healthcare and Social Assistance Industry.

Healthcare establishments are concentrated in areas with high population density. California has the highest number of facilities, followed by New York, Texas, Florida, and Pennsylvania. California has more than 67,000 ambulatory healthcare, hospital, and nursing and residential facilities, which employ over one million people per year. Table II-1 presents the number of healthcare establishments, the number of healthcare employees, and the total healthcare receipts in each of the 50 states and the District of Columbia. The information is ordered by number of establishments.

Table II-1: Number of Healthcare Establishments, Number of Healthcare Employees, and Total Healthcare Receipts, by State

State	Establishments	Paid Employees	Receipts ($1,000)
California	67,049	1,084,719	93,742,883
New York	37,640	968,004	68,576,184
Texas	35,543	790,629	53,894,354
Florida	33,863	664,362	49,513,538
Pennsylvania	25,826	626,842	42,445,050
Illinois	21,107	519,598	36,820,144
Ohio	20,872	535,457	34,537,846
Michigan	19,135	431,813	29,168,412
New Jersey	18,508	354,546	27,056,992
Georgia	12,802	290,674	22,242,191
Massachusetts	12,799	389,529	25,146,242
North Carolina	11,669	319,631	21,908,538
Virginia	11,273	247,869	17,692,485
Washington	11,157	222,782	15,460,294
Maryland	10,709	225,103	15,968,224
Indiana	10,076	263,591	16,950,896
Missouri	9,813	274,628	17,365,887
Tennessee	9,756	257,050	18,489,619
Wisconsin	9,173	245,975	15,368,388
Arizona	8,800	159,723	11,947,321
Colorado	8,334	151,265	10,772,791
Minnesota	8,081	157,894	9,864,404
Louisiana	8,026	214,367	13,843,010
Connecticut	7,444	93,899	6,241,205
Oregon	7,212	127,530	8,518,910
Alabama	6,706	180,407	12,688,762
Kentucky	6,647	171,005	11,345,390
Oklahoma	6,601	147,287	8,832,649
South Carolina	5,783	136,320	9,597,946
Iowa	5,355	98,979	5,129,312
Kansas	4,868	66,756	3,667,767
Arkansas	4,471	108,101	6,870,149
Mississippi	3,828	112,359	7,577,714
Utah	3,658	71,790	4,795,081

Table II-1: Number of Healthcare Establishments, Number of Healthcare Employees, and Total Healthcare Receipts, by State (Continued)

State	Establishments	Paid Employees	Receipts ($1,000)
West Virginia	3,461	83,485	5,526,231
Nevada	3,010	49,295	4,434,559
New Mexico	2,933	64,709	4,134,335
Nebraska	2,847	48,392	2,865,939
Maine	2,777	37,388	2,272,419
Hawaii	2,430	22,932	2,090,765
Idaho	2,351	43,029	2,678,189
New Hampshire	2,256	55,401	3,618,105
Rhode Island	2,143	31,298	2,197,746
Montana	1,967	23,902	1,294,100
District of Columbia	1,496	47,742	4,194,304
South Dakota	1,363	41,507	2,371,023
Delaware	1,356	19,353	1,367,588
Vermont	1,274	27,330	1,589,182
Alaska	1,141	20,740	1,787,722
North Dakota	1,064	27,686	1,339,141
Wyoming	972	17,728	1,076,409

Source: The 1997 Economic Census of the Healthcare and Social Assistance Industry.

The 1997 Census information did not separate Veterinary Services (NAICS 541940) from the other industries within the 5419 code category. However, according to the American Veterinary Medical Association, as of September 2002, there are 61,477 veterinarians employed in approximately 21,044 veterinary practices located across the United States. These practices have a mean gross practice revenue of $677,823 per practice per year. This information includes both private clinical practices and public and corporate employment.

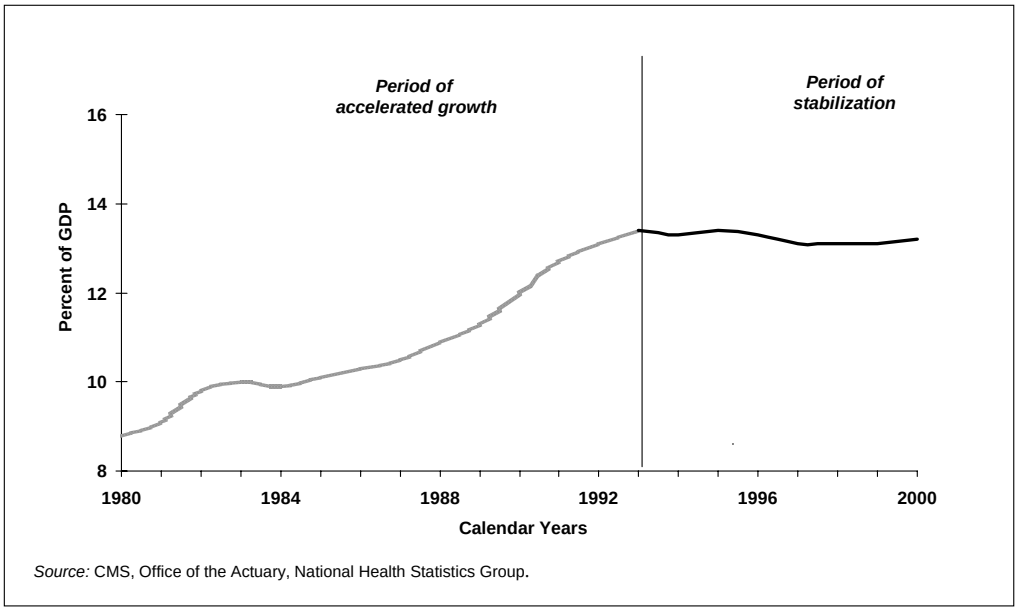
II.B.3. Economic Trends

Healthcare Expenditures as a Share of the Gross Domestic Product

According to the Centers for Medicare and Medicaid Services (CMS), the healthcare industry currently accounts for approximately 13 percent of the Gross Domestic Product (GDP) of the United States. By the year 2010, healthcare expenditures are expected to increase to 17 percent of the GDP. As shown in Figure II-4, the growth of spending has stabilized since 1993 because medical prices averaged only a 2.9 percent annual growth between 1993 and 1999. This growth is relatively minimal compared to the 11.2-percent average annual growth between 1980 and 1982, and the 6-percent average annual growth between 1982 and

1993. Another factor to consider in this stabilization is the growth in the complementary care industry (i.e., nonallopathic healthcare services), which was reported to be approximately 42 billion dollars in the mid-1990s.

Figure II-4: National Healthcare Expenditures as a Share of the GPD



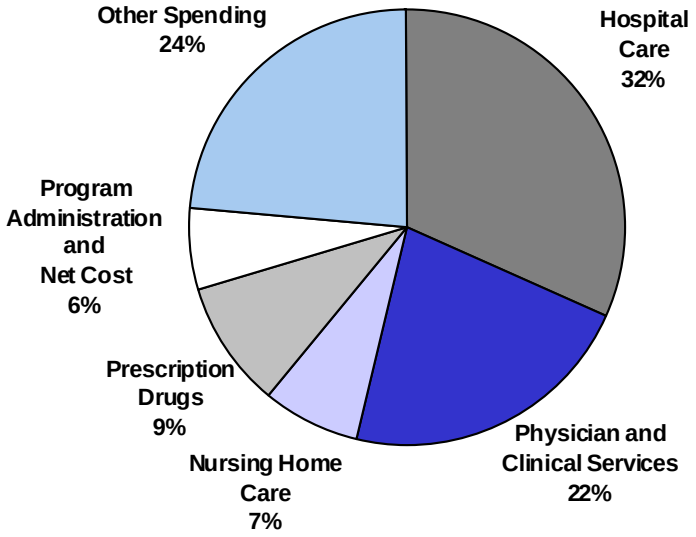
Source: June 2002 Centers for Medicare and Medicaid Services Report.

Healthcare Spending

In calendar year 2000, the United States spent $1.3 trillion on healthcare (NAICS code 62). Most of this money was split between hospital care (32 percent) and physician and clinical services (22 percent).

As shown in Figure II-5, prescription drugs accounted for 9 percent of the total healthcare spending in 2000. According to the CMS, between 1990 and 2000, prescription drug spending increased by more than 3 percent while the amount of money spent at hospitals decreased by 4.8 percent.

Figure II-5: The Nation's Health Dollar, CY 2000



Total Health Spending = $1.3 Trillion

Note: Other spending includes dentist services, other professional services, home health, durable medical products, over-the-counter medicines and sundries, public health, research and construction.

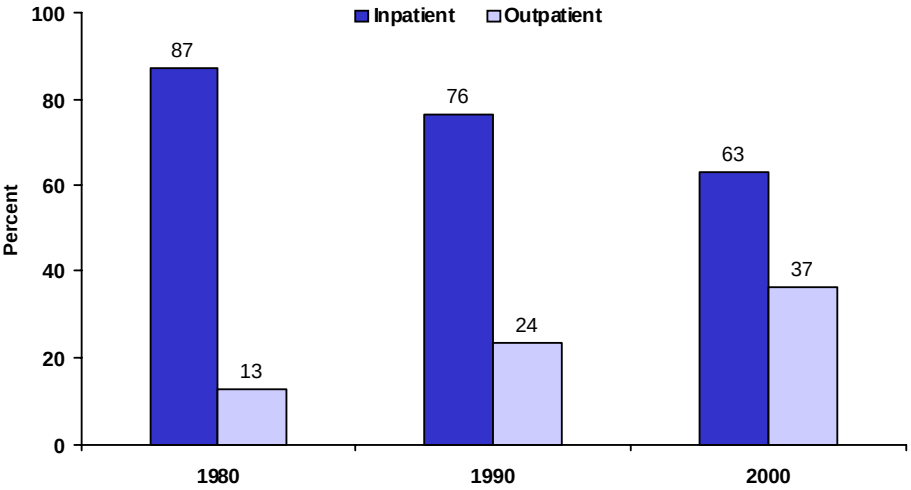
Source: CMS, Office of the Actuary, National Health Statistics Group.

Source: June 2002 Centers for Medicare and Medicaid Services Report.

Inpatient Care Versus Outpatient Care

The implementation of Medicare prospective payment systems and the increased enrollment into various managed care programs have contributed to the decreased length of patient hospital stays since 1980. According to the CMS, in 1980, the average length of a hospital stay was between 7 and 8 days. In 1999, it was approximately 2 to 3 days. These factors, along with advances in technology and pharmaceuticals available to treat diseases, have also led to a decline in the number of inpatient hospital procedures. As shown in Figure II-6, inpatient care accounted for 87 percent of hospital procedures in 1980. In 2000, that number was down to 63 percent.

Figure II-6: Community Hospital Expenditures: Inpatient and Outpatient Shares for All Payers



Note: Community hospitals are all non-federal, short-term general, and special hospitals whose activities are available to the public.

Source: CMS, Office of the Actuary, National Health Statistics Group.

Source: June 2002 Centers for Medicare and Medicaid Services Report.

III. ACTIVITY DESCRIPTIONS

As discussed in Section II.B.1 of this Notebook, the healthcare industry is most often described by speciality or service area. This section describes key functions within the healthcare industry that create wastes that must be carefully managed to mitigate environmental pollution.

Healthcare is a very dynamic field. Institutions are changing at a rapid rate, adding new activities and shedding others. To understand what wastes might be generated in any given facility, it is important to have a clear understanding of the activities that are housed in the facility. This section describes selected key activities and the wastes these activities create, and discusses issues related to proper handling and disposal. In some cases, it is the disposal decisions that are responsible for the pollution created, as in the case of waste incineration (i.e., dioxins and mercury air emissions) or mislabeled red bag waste. In other cases, it is the actual materials necessary to be used in healthcare processes that create the pollution (e.g., ethylene oxide used in sterilizing critical healthcare devices).

III.A. Healthcare Activities

Thousands of activities take place daily within the healthcare sector. While the desired outcome of delivering healthcare services is improved health for patients and the community, many of the activities of the healthcare sector are not directly related to patient care. Maintaining physical facilities, substantial amounts of diagnostic and testing activities, key administrative services, and research activities are not direct forms of patient care. In fact, the majority of wastes produced in a hospital (more than 50 percent of waste can be cardboard and office paper) never comes in direct contact with patients.

In some healthcare facilities, activity areas may be separately owned and operated, or run by contractors. It would not be unusual to find laboratory services at a hospital owned and run by a private firm, housekeeping run by a contract cleaning service, food service operated by another vendor or series of vendors, and dialysis run by another private service. As a result, knowledge of and control over environmental issues and wastes can be decentralized and scattered.

Producing an exhaustive list of every healthcare activity would be extremely cumbersome and ultimately would not focus on those functions within healthcare that create problem wastes and pollution. Nor would it equip the reader with information and strategies for identifying and mitigating the waste. Instead, this Notebook identifies 17 key functions and major activities that are the major sources of waste and pollution within health sector institutions. These activities, and the wastes produced and environmental impacts that may be associated with them, are described below.

Administrative Activities and Services

All healthcare settings include administrative functions, which can include offices, billing services, medical records, public relations/marketing, nursing care documentation, human resources, security services, social services/care management, retail services, shipping and receiving, and printing/copying.

From this standpoint, healthcare institutions can be viewed similarly to office settings. From an environmental management perspective, the majority of waste from these functional areas is paper. Specific activity locations within this category that deserve closer scrutiny include:

- **Shipping and Receiving** - The majority of "product" coming into any facility will pass through a central receiving area, where it is inventoried, temporarily warehoused, and then distributed to various departments. A number of hazardous materials used in any facility pass through this point, and some are stored here. It is important to note that some individual departments in some facilities may have direct ordering, bypassing shipping and receiving. These may include areas such as the lab, facilities management, food service, or housekeeping.

- **Retail Services** - Increasingly, hospitals are changing to respond to patient demands and to seek alternative revenue streams. To accomplish these goals, some facilities are bringing banking, childcare centers, shopping, and food services onto the hospital campus through a lease or other arrangements to provide patients with the ability to access their daily needs without running to different locations.

- **Printing and Copying Services** - These services range from individual printers and copiers found throughout the facility to centralized copy shops or even professional print shops.

Support Services

A wide range of support services can be found under one roof whether a healthcare facility is large or small. These support services can include information services, food services, laundry services, pharmacy, central sterile reprocessing, and biomedical engineering. In some cases, the support services are contracted services. Wastes from support services vary greatly by support area.

- **Information Services (IS)** - The reliance on computers and electronic technologies for all levels of function is growing at a rapid pace. IS might be responsible for managing portable electronic devices and repairing or disposing of dysfunctional or older equipment including computers and monitors.

- **Purchasing** - All of the products that are handled by shipping and receiving are bought through the purchasing department. Wastes in this department consist mostly of paper and paper products but can also include pallets, shrink wrap, and cardboard.

- **Food Services** - Facilities utilize a large number and amount of products, from meats and vegetables, to canned goods, cleansers, disinfectants, and pesticides which generate solid and organic wastes. The food service at a large healthcare facility can be the largest restaurant in the community, and should be examined in that light from a compliance standpoint. These facilities store and use numerous chemical cleaners, and if "pest" control is not contracted out, a number of pest control devices and chemicals can be present. Additionally, chlorofluorocarbons might be present in freezer and refrigeration units. Special wastes, such as kitchen grease from fryalators need separate collection and disposal to avoid drain disposal or disposal as a "solid" waste. Drain disposal of wastewater from dishwashing and food preparation must also be monitored to avoid excess grease, harsh chemicals, or an excessive amount of organic substances (increased BOD) from being discharged to the sanitary sewer.

- **Laundry Services** - Although many healthcare facilities have contracted out to commercial laundries, some laundry services still exist within hospitals. Water use, boilers for hot water, detergents and disinfectants are all environmental areas of concern. Hospital laundries may process large quantities of linens contaminated by blood and body fluids. This is seldom of concern to a publicly owned treatment works (POTW) directly, but is the reason for the use of industrial detergents and disinfectants.

- **Pharmacy Services** - This is an essential service that includes the compounding and dispensing of pharmaceuticals. Pharmaceuticals are received and prepared for administration within a pharmacy setting, generating large quantities of paper and plastic waste from product packaging and inserts. Administration of pharmaceuticals to patients and the resulting residual waste can take place in any number of clinical areas within a healthcare setting, including patient care floors, surgical suites, and free-standing clinic settings. Pharmaceuticals can also be packaged for administration in home-care settings. There are a number of common pharmaceuticals that are listed as RCRA P- or U- listed waste and many others that meet the criteria for RCRA characteristic waste. The pharmacy function may take place in one central location, may be off site, or may have a number of satellite sites throughout a facility. Of particular importance is the management of the large amounts of expired, unused, or partially used pharmaceuticals, the control of chemotherapeutic agents, and management of contaminated materials and containers, as well as residual or bulk amounts of chemotherapy product. Drug classes to be concerned about include: antineoplastic (toxic, mutagenic, persistent,

accumulative), steroids (persistent, reproductive effects), antibiotics (persistent, bacterial resistance), antifungal (toxic, mutagenic, target organs, endocrine effects), antiviral (toxic, mutagenic, chronic effects), vaccines with thimerosal (contains mercury), and contrast reagents (with barium). Of less concern are recombinant proteins, analgesics, antihistamines, antiemetics, and electrolytes.

- **Central Sterile Reprocessing and Distribution (CSRD)** - This service function provides support for surgical services and other departments requiring sterile products. Typically a CSRD unit includes a 'dirty' or decontamination area that receives and cleans used equipment, and a 'clean' area that manages sterilized and cleaned products for redistribution throughout the facility. CSRD units usually work very closely with surgical services units, endoscopy units and other care units requiring a ready supply of key materials routinely cleaned and distributed from within the organization. Often these areas house ethylene oxide sterilizers, steam sterilizers (autoclaves) and chemical treatment (steris, sterrad) units. Solid and biohazardous wastes are regularly generated in these areas. Select hazardous chemical wastes may be generated depending upon the types of processes used at a given site. Water discharges from chemical processes and autoclaves should be monitored. Air discharges should be monitored if ethylene oxide (EtO) is utilized.

- **Biomedical Engineering** - This service function provides support to the many types of equipment and devices used in providing direct patient care and support services. Biomedical engineering can be an in-house function or a contracted service and would include calibrating blood pressure monitoring devices (both mercury and nonmercury). Often, a mercury sphygmomanometer and/or barometer is used to aid in calibration. Biomedical engineering often handles the increasingly large quantity of batteries (including NiCD, NiHydride, Lead acid, Lithium, dry cell) that have to be tested and changed out in many different types of equipment.

Facilities Management, Maintenance, and Plant Operations

The maintenance of a hospital or healthcare facility includes housekeeping, maintenance shops (paint, electric, plumbing), heating ventilation and air conditioning (HVAC) systems, water treatment, waste treatment, aboveground tanks, underground tanks, fleet management, groundskeeping, and pest management. It is similar in many ways to the maintenance of a large commercial or light manufacturing facility. It has many of the same functions and generates many of the same environmental concerns involving waste, air, and water issues.

- **Housekeeping or Environmental Services** - Cleaning complex facilities with many varying needs for cleanliness, ranging from "clean" to "sterile," requires the use of chemical agents, technologies, and water.

Maintaining surfaces (e.g., floors, walls, counters, sinks, toilets, furniture, and equipment) requires the use of a large range of cleaners, disinfectants, and treatments. Cleaning floors can involve the use of strippers and waxes, as well as cleansers. Housekeepers are also often charged with collecting, transporting, and overseeing the storage of all the wastes generated, including solid waste, biohazardous waste, and hazardous chemical wastes. In addition, they often operate equipment that uses hydraulic fluids (compacters and balers).

- **Engineering and Maintenance** - These functions and the scope of this service is defined differently in different settings. Often, there is overlap between the housekeeping staff, maintenance staff, and engineering staff duties. Maintenance functions, including painting, electrical work, plumbing, and carpentry, are sometimes internal functions with full shop areas in place to provide these services. Solvents, degreasers, cleaners, oil paints, and a number of toxic and often flammable products are regularly used, stored, and disposed of. Large amounts of chemicals are required in maintaining the HVAC and water treatment systems, boilers, and coolers. Monitoring systems for air emissions and water discharges must be maintained. Staff serving in these functions also are often responsible for changing out lighting fixtures and bulbs, generating waste fluorescent bulbs and lighting ballasts. Mercury management is often a primary concern in this service, as mercury is often found in devices throughout the facility in thermostats, mercuric oxide batteries, switches and relays in alarms and other electrical equipment, gauges and switches on boilers, as well as in additives to paints, cleaners, and other chemicals.

- **Waste Treatment** - Technologies might be on site and in operation to treat the facility wastes. These technologies could range from wastewater pre-treatment, an incinerator (solid and biohazardous waste), to an autoclave (biohazardous waste) to distillation units for solvents, alcohols, and formalin (usually located in conjunction with the lab), to bulb crushers (fluorescent bulbs). Emissions (primarily air) are of concern with all of these, as are residual wastes. Additionally, the treatment and disposal process may convert some materials that are nonhazardous into hazardous waste. Incineration of PVC plastics, products, and packaging (which comprise a portion of plastic wastes in healthcare) can create dioxins when incinerated. Many facilities collect biohazardous waste in red bags and red sharps containers and certain chemotherapy wastes in yellow bags. The colors in these containers can be from cadmium-based pigments, although the use of cadmium has been phased out in recent years. Cadmium, a hazardous air pollutant, can be released if these containers are combusted as part of the treatment process.

- **Fleet Management** - Vehicles of various kinds can be owned, leased, or used through a contracted service. Facilities that maintain a fleet (this can

range from golf carts, to cars, trucks and vans, to ambulances, to helicopters) must determine how to address maintenance and cleaning of the vehicles, as well as fuel storage. Wastes to be addressed include waste oil, solvents, tires, batteries, and coolants/CFCs.

- **Groundskeeping** - Landscaping, mowing, snow removal, and pest management increasingly are services that are contracted out. Use of fertilizers, herbicides, pesticides, and deicing substances needs to be carefully monitored for releases and run-off. Similarly, pest control is often a contracted service.

Laboratory Services

Thousands of medical and diagnostic tests and services are performed on a daily basis, even in small labs serving healthcare facilities. These services can include hematology, microbiology, chemistry, blood bank, surgical pathology, and histology. The functions of laboratory testing are highly varied, and involve a number of separate processes. Labs utilize large volumes of a few chemicals (e.g., xylene, alcohol, formalin) and small quantities of a large number of other substances. Labs tend to expend many of the chemicals used in testing through evaporation or dilution and disposal to the sanitary sewer. Both air and water emissions are of concern. Larger quantities of some chemicals may be collected for disposal, or in some cases may be reprocessed for reuse within the lab. More information is available at: *Environmental Management Guide for Small Laboratories*, EPA 233-B-00-001, May 2000, Office of the Administrator (2131), *http://www.epa.gov/sbo/smalllabguide_500.pdf*.

Labs can be free-standing entities or part of a larger facility. If they are within a larger facility, they still may be privately owned and operated, or operated under contract. Consequently, responsibility for managing hazardous materials and wastes can be complicated.

Disinfecting equipment and materials is important to the accuracy of lab functions, so a range of disinfecting solutions is often found in labs. Autoclaves are often used to sterilize equipment that has been cleaned for reuse, and they may be available in labs to pretreat some wastes (e.g., culture plates) prior to disposal.

Many labs have automated chemical analyzer systems. These systems contain many reagent reservoirs and reagents with preservatives. It is often necessary to contact the manufacturer to identify all potential chemical waste locations within the system.

A range of mercury-containing devices in labs is still not uncommon, sometimes due to the age of equipment or interpretation of accreditation standards that require mercury calibration equipment.

Wastes that are commingled (biological samples and chemicals) are also common, especially in surgical pathology where tissue samples in formalin have to be processed and in many cases stored for extended periods.

Diagnostic Services

An increasingly diverse and large number of diagnostic services are now available. These can include, but are not limited to endoscopy, cardiac catheterization, radiology (CT, MRI, digital imaging), nuclear medicine, sleep studies labs, and electroencephalograph studies (EEG). Diagnostic services are often found in association with medical centers but in some cases can be free-standing facilities.

- **Endoscopy and Cardiac Catheterization** - New techniques in these areas have resulted in less biohazardous waste generation but an increased use of high-level disinfectants (e.g., glutaraldehyde) or sterilants (e.g., ethylene oxide (EtO) gas), both of which represent significant hazards as releases to water or air.

- **Radiology** - These functions have traditionally involved the use of film and film-developing chemicals. Radiology activities can occur within a hospital center, urgent care setting, outpatient clinic, dental offices, or other care areas that require X-rays to help evaluate healthcare conditions. Although many healthcare organizations are transitioning away from wet processing and silver-containing films to digital imaging and PAX-it brand systems, heavy metals waste is generated through a number of activities in Radiology. In particular, lead shields are used to shield patients from exposure. These shields wear out over time, and should be managed as a hazardous waste or sent back to the supplier for remanufacture into a smaller shield device. Additionally, contrast reagents are not always fully consumed by the patient and will result in hazardous waste if discarded unused.

- **Nuclear Medicine** - This branch of diagnostic testing primarily offers diagnostic imaging and radioisotope treatment. Radionuclides are used in various tests and procedures and require careful management, storage, and monitoring until they are safe for disposal. Radioactive waste may also be RCRA hazardous waste, which should be separated from the nonhazardous waste prior to decay storage.

Surgical Services

Surgical services include anesthesia, preoperative services, ambulatory outpatient services, surgery, and post-anesthesia care. Advances in surgery have vastly reduced the invasive nature of different procedures and correspondingly reduced the amount of biohazardous wastes (e.g., blood and body-fluid-contaminated wastes) generated. However, surgery functions still represent one of the highest waste-generating areas. Many of the new surgical devices represent environmental challenges, such as batteries with heavy metals that must be managed, or devices that require special chemical disinfection or sterilization.

In most areas, the majority of surgery is performed as ambulatory, or "day" surgery. These procedures do not require that patients stay overnight. As a result, what was previously a highly centralized function is now very decentralized, with many of the specialized wastes being generated outside of large institutions.

Special wastes can be found in anesthesia services and surgical pathology units. Anesthesiologists and nurse anesthetists administer to patients during surgical procedures and provide pain management services. Waste anesthetic gases from care delivery must be managed to prevent releases. Careful management of compressed gas cylinders (e.g., oxygen, nitrogen, and argon) is also a safety concern. Surgical pathology units can present a host of hazardous chemicals to monitor, as tissue samples are taken and preserved in formaldehyde, or a dilute version, formalin (e.g., biopsies and surgical excisions).

Inpatient Care Services

The need for inpatient care services has declined in the last decade, with an increasing number of services being offered on an out-patient basis (e.g., stay at the facility is less than 24 hours). Specialized treatment for many acute and chronic conditions or more serious illness or injury still requires overnight and longer terms stays in hospitals and other types of healthcare institutions. The primary concerns in waste are usually limited to the management of biohazardous wastes (mostly sharps), the use of cleaners and disinfectants, and, as in all patient care areas, the possible presence of mercury-containing devices (e.g., fever thermometers, sphygmomanometers, and a variety of pharmaceutical products). Some services, such as dialysis and oncology (discussed below), can be delivered in these areas. Inpatient care services include medical surgical care, orthopedic care, neurology care, urology care, cardiac care, psychiatric/behavioral health, geriatric care, palliative care, cancer care, maternal child care (labor and delivery/birthing, postpartum care, nursery, pediatrics), pediatric care, and rehabilitative care.

Critical Care Services

Critical care inpatient services such as surgical intensive care, medical intensive care, pediatric intensive care, cardiac intensive care, burn care, and neonatal intensive care are conducted in hospital facilities. Many critical care waste concerns are the same as in other inpatient service areas (discussed above). In addition, specialized monitoring equipment and an array of pharmaceuticals are used in these areas. Two common drugs used in critical care areas that become hazardous when disposed of are epinephrine and warfarin (Coumarin).

Emergency Care Services

Emergency care services are offered in different types of settings, both in very large and small hospitals, as well as in free-standing units. While care offered in these types of service units is meant to be limited in time and scope, they are often designed to provide a wide range of services, as their goal is to respond to "emergencies." These services entail a large degree of response to unpredictable situations, including emergency response to industrial accidents and bioterrorism incidents. Additionally, as the ranks of uninsured Americans grows,

it is common for individuals to seek routine care in emergency department settings, rather than at physicians' offices.

Emergency service areas are also responsible for disaster response management, and many institutions have set up decontamination rooms in association with emergency services. Such rooms are designed to allow individuals who have been exposed to chemicals or biological agents to be safely decontaminated before entering the emergency service area. Decontamination can involve using chemicals and copious amounts of water. Facilities should have a system of trapping the wastewater so that they can test and then properly manage the wastes.

Many emergency service waste concerns are the same as in other patient care service areas (see above) and include biohazardous wastes, chemicals for cleaning and high-level disinfection or sterilants, the possible presence of mercury-containing devices, and the possibility of pharmaceutical wastes.

Other activities that may also be present as part of emergency services include storing formalin for preserving specimens, operating X-ray technology, and managing photographic chemicals, wastewater, silver recovery, and films. Given the range of instruments used, there may also be disinfectant chemicals, such as glutaraldehyde, or other high-level disinfectants present.

Respiratory Care Services

A variety of wastes are generated through respiratory care functions, which include pulmonary function testing and oxygen therapies. Reprocessing some equipment may involve using high-level disinfectants. As in other patient care areas, mercury devices and batteries could be used. Special management concerns include pressurized tanks such as oxygen.

Dialysis

Dialysis can be conducted in a wide variety of settings, from homes to specialty clinics to large hospital facilities. There are different types of dialysis. Hemodialysis involves external technologies that filter the blood using a mechanical dialyzer. Peritoneal dialysis involves pumping dialyser fluids into the patient's abdominal cavity and using the peritoneum liner as a natural filter. Areas conducting hemodialysis can generate larger amounts of biohazardous wastes due to the nature of the process. The waste often contains large amounts of liquid and is heavy.

Hemodialysis equipment requires water treatment and the use of high-level disinfectants. In the past, formaldehyde was commonly used to clean machinery. Today, less toxic disinfectants are primarily used.

Physical Therapy/Occupational Therapy

Generally, these areas generate little waste of concern. As in other patient care areas, mercury devices could be used. Biohazardous waste, such as sharps, forceps, blades, or lancets may be generated, especially if wounds/burns are debrided and treated in these areas. If prosthetic devices are made on site, chemicals related to leather working (tanning chemicals, adhesives) and plastics molding may be used.

Outpatient Services (Nonsurgical)

Outpatient services include womens' health/gynecology, general medicine, family practice, specialty clinics (e.g., orthopedics, urology, pulmonology, allergy), pediatrics, and rehabilitative services.

Generally, these areas generate little waste of concern. As in other patient care areas, mercury devices could be used. In some cases, formalin may be used to preserve tissue samples (biopsy). Sharps management is the biohazardous waste management concern. As in many patient care functions, a variety of pharmaceutical products may be present. For example, trichloroacetic acid and potassium hydroxide, both characteristic (corrosive) wastes are usually used in OB/GYN practices.

Oncology/Cancer Care Services

Oncology care includes administering chemotherapy medications to cancer patients. In radiation oncology, treatment can involve intravenously administering radioactive isotopes and applying radiation externally to cancer patients. These treatment activities are sometimes grouped together but are often found separately. They may take place in either outpatient or inpatient settings. In some cases, chemotherapy is administered through home-based treatment programs.

Antineoplastic, or cytotoxic, agents that are used to produce chemotherapy solutions are generally procured through a central purchasing area or directly from the pharmacy. Chemotherapy medications may either be prepared in a special area within the hospital pharmacy or prepared in a special area in the oncology unit (in-patient or outpatient type of unit). The amount and type of chemotherapy found in any institution depends on the amount of care/ number of procedures provided and physician preferences for ordering pharmaceuticals. In the preparation area, work is conducted in a safety cabinet equipped with the appropriate filters. Facilities must maintain the filters and determine if they require special disposal, which is often done under a maintenance contract. Residuals from preparation include any contaminated materials including vials, bottles, IV bags, packaging, and personal protective equipment. Proper segregation containers need to be available for materials determined to be RCRA waste, or as nonhazardous materials (often personal protective equipment and packaging) that can be collected separately. Chemotherapy wastes that are not classified as RCRA waste must be properly labeled as chemotherapy-containing materials (e.g., collected in yellow bags) but they can be sent out for incineration (or other technologies as they become available) with the institution's biohazardous waste. Note that if an unregulated chemotherapy waste is

contaminated with a RCRA hazardous waste, RCRA regulations apply. Radiation therapy areas will contain radioactive materials that must be properly handled and monitored.

Dentistry

Dentistry services, including oral surgery, periodontics, and oral healthcare, are provided in a wide range of settings from individual private practices to dental surgery centers that are free standing or located within large teaching and research hospitals. It is estimated that dental facilities in the United States used 40 metric tons of mercury in 1997, which may be placed in teeth, recycled, discharged into wastewater, or disposed of as waste.[2] Approximately 50 percent of dental amalgam is mercury. A study by the Association of Metropolitan Sewerage Agencies found that dental offices are the largest source of mercury to POTWs, contributing more than 35 percent of mercury influent to the POTWs studied.[3] Other studies have estimated the contributions to be as high as 80 percent.[4]

Mercury in dental amalgam can enter the environment in a variety of ways. Dental amalgam waste that is generated (for instance, excess amalgam that is not placed in a tooth, or amalgam that is captured by traps and filters in the dental office) can release mercury into the environment if it is not managed properly. When amalgam restorations are placed in or removed from teeth during dental work, amalgam can enter dental wastewater; when it reaches a wastewater treatment plant, a small percentage of the mercury in the amalgam will be discharged by the plant.

While amalgam has very low solubility in water, a small percentage can be released in a bioavailable form and be converted to methylmercury, the form that accumulates in the food chain, presenting potential health risks to humans and wildlife who consume contaminated fish. Most of the mercury that reaches sewage treatment plants (in excess of 90 percent) is likely to be captured by the treatment plant and enter the sewage sludge, or biosolids.[5] These biosolids may be land-applied, landfilled, or incinerated. Incineration will likely volatilize mercury back into the environment.

Other wastes from dentistry include X-ray wastes (developer chemicals, silver discharges, lead shields), high-level disinfectants, chemical sterilizers, nitrous oxide, and biohazardous wastes, especially sharps. A simple guide to waste management specific to dentistry practices and wastewaters can be found at the following web sites:

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[2] Stone, Mark E., DDS, 2004. "The Effect of Amalgam Separators on Mercury Loadings to Wastewater Treatment Plants," *CDA Journal*, Vol. 32, No.7, July 2004.

[3] Association of Metropolitan Sewerage Agencies (2002). *Mercury Source Control & Pollution Prevention Program Evaluation: Final Report*. March 2002 (Amended July 2002).

[4] Stone, 2004.

[5] Options for Dental Mercury Reduction Programs: Information for State/Provincial and Local Governments, A Report of the Binational Toxics Strategy, Mercury Workgroup Co-chairs
Alexis Cain, U.S. Environmental Protection Agency, Robert Krauel, Environment Canada,
http://www.epa.gov/region5/air/mercury/dentaloptions3.pdf, December 16, 2003, Revised August 4, 2004.

- A Guide for Dentists: How to Manage Waste From Your Dental Practice University of Wisconsin—Extension *http://www.uwex.edu/shwec/Pubs/pdf/guidefordentists.pdf*

- Guidelines for New Mexico Dental Facilities Waste-Management, Education and Research Consortium *http://www.cabq.gov/p2/pdfs/dentalbooklet.pdf*

- Characteristics and Treatment of the Dental Wastewater Stream University of Illinois, Chicago *http://www.wmrc.uiuc.edu/main_sections/info_services/library_docs/rr/RR-97.pdf*

- Options for Dental Mercury Reduction Programs: Information for State/Provincial and Local Governments, U.S. EPA and Environment Canada *http://www.epa.gov/region5/air/mercury/dentaloptions3.pdf*

- Northeast Waste Management Officials' Association (NEWMOA) has both a Dental Mercury Topic Hub *http://www.newmoa.org/Newmoa/htdocs/prevention/topichub/toc.cfm?hub=103&subsec=7&nav=7* and a list of links to articles , fact sheets, and case studies *http://www.newmoa.org/Newmoa/htdocs/prevention/topichub/bibliography.cfm?hub=103&subsec=7&nav=100*

- The Environmentally Responsible Dental Office: A Guide to Proper Waste Management http://www.delta-institute.org/pollprev/mercury/linkfiles/VTdentalguide.pdf

Animal Research and Testing

This testing represents a wide rage of activities that can occur at free-standing research laboratories or in association with healthcare facilities. The research is usually independently funded, varied, and conducted out of the usual system of procurement at the facility. The activities and wastes of concern can encompass all of those usually encountered in labs, with the addition of animal care and housing. Animal care facilities may have antibiotics and pharmaceuticals in the animal's drinking water. Also, the facility may wash the animal cages with corrosive reagents. The waste can also include chemicals and materials not usually associated with the general delivery of healthcare services. Any facility sponsoring animal research and testing should maintain an inventory of materials currently in use and stored at the facility.

Clinical Research

Like animal research and testing, clinical research represents a wide rage of activities that can take place at free-standing research laboratories or in association with healthcare facilities. The research is usually independently funded, varied, and conducted out of the usual system of procurement at the facility. The activities and wastes of concern can

encompass all of those usually encountered in labs and under many patient care and treatment activities. It can also include chemicals and materials not usually associated with the general delivery of healthcare services. Any facility sponsoring clinical research should maintain an inventory of materials currently in use and stored at the facility.

Construction and Renovation

Construction and renovation are constant activities in healthcare settings. The largest portion of wastes is that common in any construction and demolition (C&D) waste stream, mainly solid waste. However, there may be some special concerns, including stormwater control, asbestos and lighting ballasts, as well as less obvious ones like mercury. While mercury would be commonly associated with thermostats and other switches or gauges, a number of healthcare facilities undergoing renovation projects have found residual mercury in drains and traps.

III.B. Waste Streams Generated by the Healthcare Industry

There are many variables affecting healthcare waste generation, including:

- The type of products and materials purchased for use;
- The type of waste segregation systems in place;
- The degree to which problem wastes are identified and mitigation strategies are implemented; and
- The location of care delivery (in a hospital, clinic, or home).

This subsection presents a brief overview of the major waste streams in healthcare. Chapter IV of this Notebook will provide a broader profile of the major wastes and waste streams. Note that states and local regulating bodies may impose more stringent definitions of waste and more stringent waste requirements than those established by EPA and other federal agencies.

In response to the Medical Waste Tracking Act (MWTA) of 1988, the Society for Hospital Epidemiology produced a position paper entitled *Medical Waste*[6]. Its focus was on the majority of wastes that are produced by healthcare activities and are generally classified as solid waste or biohazardous wastes. It did not address the chemical or radioactive wastes from the sector. This paper provided the most authoritative and comprehensive definition, characterization, profiling, and analysis of risks from healthcare wastes to date.

[6] (Rutala WA, Mayhall CG, "The Society for Hospital Epidemiology of American (SHEA) Position Paper: Medical Waste." *Infection Control Hospital Epidemiology*. 1992; 13:38-48).

Healthcare wastes can be categorized as follows:

- Municipal solid waste;
- Biohazardous waste (regulated medical waste);
- Hazardous waste:
  - Listed and characteristic waste,
  - Commingled waste,
  - Pressurized containers and ignitable compressed gas, and
  - Universal waste; and
- Waste by media category:
  - Wastewater,
  - Stormwater, and
  - Air emissions.

Each of these areas is described in detail below.

III.B.1. Municipal Solid Waste

The majority of healthcare wastes are produced under circumstances identical to restaurants and food industry facilities, hotels, and office complexes. The industry generates large volumes of solid wastes (much of what could be subcategorized as recyclable wastes). Studies indicate that 1 percent of all solid waste produced in the United States is generated by healthcare facilities. There have been numerous studies of these wastes, including ways to manage them to minimize waste and environmental impacts. In 1993, the American Hospital Association (AHA) published a manual for its members, *An Ounce of Prevention: Waste Reduction Strategies for Health Care Facilities* (Bisson, McRae and Shaner). Since then, state hospital associations, state solid waste agencies, and a number of private organizations have produced additional manuals. A cooperative program between the EPA and the American Hospital Association, Hospitals for a Health Environment (H2E) is compiling recent materials; this compilation can be found at: *http://www.h2e-online.org/*.

A special subcategory of municipal solid waste to be considered is construction and demolition (C&D) debris. During remodeling, C&D debris can fall into several categories of waste. Healthcare facilities must identify which materials are RCRA Subtitle C hazardous waste (discussed in Section VI of this document), including lead shielding, lead paint, and demolished equipment containing lead, mercury, silver and/or cadmium (especially batteries, fluorescent light bulbs, and computer monitors). Facilities may identify some construction and demolition debris that is recyclable, which can reduce disposal cost. Also, some C&D debris is municipal solid waste, but is generated at a large enough volume to warrant separate disposal in a construction and debris landfill.

III.B.2. Biohazardous Waste (Regulated Medical Waste)

The concern with and need for better management of healthcare waste that triggered the Medical Waste Tracking Act largely relates to those wastes in healthcare that can potentially harbor and transmit infectious diseases. This includes a wide range of materials that are considered contaminated or pose special risks (e.g., sharps). This category of wastes is defined by regulation at the state, tribal, or local level.

There is general agreement on certain characteristics and components of this waste as noted in the list below, but the specific definitions of this waste are defined on a state-by-state basis, and there are sometimes significant differences in those definitions between states. Further, what and how much waste falls into this category can vary widely depending on the interpretation of these regulations by the generator on a facility-by-facility basis, even within states.

Terminology used to describe this waste category is often confusing and used interchangeably. Words such as "*biohazardous waste*," "*infectious waste*," "*infectious medical waste*," "*potentially infectious material*," "*contaminated trash*," and "*regulated medical waste*," are examples of the terms used in describing this segment of healthcare wastes.

Wastes usually considered in this category include[7]:

- Cultures and stocks of infectious agents and associated biologicals, including: cultures from medical and pathological laboratories; cultures and stocks of infectious agents from research and industrial laboratories; wastes from the production of biologicals; discarded live and attenuated vaccines; and culture dishes and devices used to transfer, inoculate, and mix cultures.

- Human pathological waste, including tissues, organs, and body parts and body fluids that are removed during surgery or autopsy, or other medical procedures, and specimens of body fluids and their containers.

- Human blood and blood products including: (i) liquid waste human blood; (ii) products of blood; (iii) items saturated and/or dripping with human blood; or (iv) items that were saturated and/or dripping with human blood that are now caked with dried human blood, including serum, plasma, and other blood components, and their containers, which were used or intended for use in either patient care, testing and laboratory analysis or the development of pharmaceuticals. Intravenous bags are also included in this category.

[7] Definition taken from the Federal Plan Requirements for Hospital/Medical/Infectious Waste Incinerators Constructed On or Before June 20, 1996.

- Sharps that have been used in animal or human patient care or treatment or in medical, research, or industrial laboratories, including hypodermic needles, syringes (with or without the attached needle), Pasteur pipettes, scalpel blades, blood vials, needles with attached tubing, and culture dishes (regardless of presence of infectious agents). Also included are other types of broken or unbroken glassware that were in contact with infectious agents, such as used slides and cover slips.

- Animal waste including contaminated animal carcasses, body parts, and bedding of animals that were known to have been exposed to infectious agents during research (including research in veterinary hospitals), production of biologicals, or testing of pharmaceuticals.

- Isolation wastes including biological waste and discarded materials contaminated with blood, excretions, exudates, or secretions from humans who are isolated to protect others from certain highly communicable diseases, or isolated animals known to be infected with highly communicable diseases.

- Unused sharps including unused, discarded hypodermic needles, suture needles, syringes, and scalpel blades.

III.B.3. Hazardous Waste

There are some special waste streams that fall most logically under the heading of "hazardous" but because of their unique nature and the risks inherent in each of them, they are discussed separately below as Mixed Waste, Pharmaceutical Waste, Pressurized Containers and Ignitable Compressed Gas, and Universal Waste. The RCRA standard is cited below. States must at least accept these standards but have the right to impose stricter standards and list additional wastes.

To be considered hazardous waste under RCRA, waste must either be listed or characteristic. Listed wastes are specifically named in 40 CFR Section 261. Characteristic wastes are either ignitable, reactive, corrosive, or toxic. This subsection gives a quick overview of listed and characteristic hazardous wastes, and lists the most common healthcare hazardous wastes. The following EPA web site provides a flowchart that outlines the major steps in the hazardous waste identification process: *www.fedcenter.gov/resources/facilitytour/hazardous/whatis/flowchart/*

RCRA Listed and Characteristic Wastes

- **Listed Waste** - The four types of RCRA listed waste are F, K, P, or U, with a three-digit identifier (e.g., F005, P039, U135). EPA listed these wastes as hazardous because they are known to be harmful to human health and the environment when not managed properly, regardless of their concentrations. Some states may list more wastes as hazardous than

EPA. Visit *www.hercenter.org* to locate state-listed wastes. The lists include the following four types of waste:

— F-listed wastes. These non-specific-source wastes are material-specific, such as solvents, generated by several different industries. Waste codes range from F001 to F039. Examples of healthcare facility wastes that fit this category are solvents often used in research laboratories, pharmacies, and morgues (e.g., methanol, acetone, and methylene chloride).

— K-listed wastes. These source-specific wastes are from specifically identified industries and range from K001 to K161. Healthcare facilities typically do not produce K-listed wastes.

— U-listed wastes. These discarded commercial chemical products include off-specification products, container residuals, spill residue runoff (pure or mixed with non-active ingredients such as colorants, flavoring agents, emulsifiers, fragrances, water, etc.), technical grades (e.g., 95% pure Acetone), off-specification species, or active ingredients that have spilled or are unused and that have been, or are intended to be, discarded. Waste codes range from U001 to U411. Examples of healthcare facility wastes that fit into this category are ethylene oxide (U115), some waste pharmaceuticals such as lindane (U129) and selenium sulfide (U205), and some waste chemotherapy drugs such as chloroambucil (U035).

— P-listed wastes. Like U-listed wastes, these discarded commercial chemical products include off-specification products, container residuals, spill residue runoff spill residue runoff (pure or mixed with non-active ingredients such as colorants, flavoring agents, emulsifiers, fragrances, water, etc.), technical grades (e.g., 95% pure Acetone), off-specification species, or active ingredients that have spilled or are unused and that have been, or are intended to be, discarded. Waste codes range from P001 to P205. These wastes are considered acutely hazardous waste and as little as 2.2 lbs of these wastes generated in a given calendar month, or one quart of these wastes stored in a satellite accumulation area designates a facility as a large quantity generator. An example of a healthcare facility waste in this category is epinephrine (P-042).

Table III-1 below lists some specific examples of RCRA hazardous waste from healthcare facilities.

Table III-1: Examples of RCRA Listed Hazardous Waste Found in Healthcare Facilities

Chemical or Device Containing Chemical	RCRA Listing
Note: This list is not exhaustive but provides some common healthcare hazardous wastes.	
Solvents used in the laboratory such as xylene, ethanol, toluene, and methanol. Solvents are also used in inks for forms and menus.	Xylene, U239 Methanol, U154 Several ethanol compounds are U-listed
2-Chloroethyl Vinyl Ether	U042
3-Methylchloranthrene	U157
Acetone	U002
Acetyl Chloride	U006
Acrylonitrile	U009
Aniline	U012
Bromoform	U225
Cacodylic Acid	U136
Carbon Tetrachloride	U211
Chloral Hydrate	U034
Chlorambucil	U035
Chloroform	U044
Creosote	U051
Cresols	U052
Cyclophosphamide	U058
Daunomycin	U059
Dichlorobenzenes	U070, U071, U072
Ethyl Acetate	U112
Ethyl Carbamate	U238
Ethyl Ether	U117
Ethylene Oxide	U115
Formaldehyde	U122
Formic Acid	U123
Hexachloroethane	U131
Hexachlorophene	U132
Lindane	U129
Maleic Anhydride	U147
Melphalan	U150
Mercury	U151
Methanol/Methyl alcohol	U154
Mitomycin C	U010

Table III-1: Examples of RCRA Listed Hazardous Waste From Healthcare Facilities (Continued)

Chemical or Device Containing Chemical	RCRA Listing
Naphthalene	U165
N-butyl Alcohol	U031
Paraldehyde	U182
p-Chloro-m-Cresol	U039
Phenol	U188
Reserpine	U200
Resorcinol	U201
Saccharin	U202
Selenium Sulfide	U205
Streptozotocin	U206
Tetrachloroethylene	U210
Thiram	U244
Trichloroethylene	U228
Uracil Mustard	U237
Warfarin (Coumarin) < 0.3%	U248
Waste codes range from P001 to P205 and should be noted as acutely hazardous waste, as 2.2 lbs of these wastes generated in a given calendar month designates a facility as a large quantity generator.	
3-Benzyl Chloride	P028
Arsenic	P012
Arsenic Trioxide	P012
Chloropropionitrile	P027
Cyanide Salts	P030
Epinephrine	P042
Nicotine	P075
Nitroglycerin (unless the state adopted the federal exclusion for healthcare facilities)	P081
Osmium Tetroxide	P087
Phentermine	P046
Phenylmercuric Acetate	P092
Physotigmine	P204
Physotigmine Salicylate	P188
Potassium Silver Cyanide	P099

Table III-1: Examples of RCRA Listed Hazardous Waste From Healthcare Facilities (Continued)

Chemical or Device Containing Chemical	RCRA Listing
Sodium Azide Sodium azide is often used as a preservative in a variety of laboratory reagents usually at concentrations of less than 0.1%. It is not the sole active ingredient in these cases and would not be a P-listed waste.	P105
Warfarin (Coumarin) > 0.3%	P001
Mercury compounds such as thimerosal, amalgam, and mercury-containing fixatives. Mercury-containing equipment such as thermometers, sphygmomanometers (blood pressure measuring device), thermostats, weighted feeding tubes and fluorescent bulbs. If the state adopted the Universal Waste Rule, then fluorescent bulbs are considered universal waste.	Mercury is listed as U151, but several other mercury compounds are also listed. The RCRA toxicity characteristic (discussed below) also lists mercury (D009) and requires a limit of 0.2 mg/L.
Lead-containing equipment such as lead aprons, bitewings, lead pigs, lead shielding removed during construction or renovation, batteries, and computer monitors. If the state adopted the Universal Waste Rule, then batteries are considered universal waste.	The RCRA toxicity characteristic (discussed below) lists lead (D008) and requires a limit of 5.0 mg/L.
Silver from X-rays. Silver can come from fixer/developer solutions or from film or from devices employed to harvest silver.	The RCRA toxicity characteristic (discussed below) lists silver (D011) and requires a limit of 5.0 mg/L.

Sources: EPA Region 2 presentation dated February 2004, entitled "Identification and Management of Regulated Hazardous Waste, A Workshop Geared Toward Healthcare Facilities" and H2E's web page, at *http://www.h2e-online.org/pubs/chemmin/master.pdf*.

Note that some chemicals used in healthcare are toxic and harmful to the environment, but RCRA does not list them as hazardous waste. These include glutaraldehyde and many chemotherapy drugs (other than the nine that are listed). A best management practice is to handle such materials as if they were hazardous waste, to protect workers, patients, and the environment. For an explanation of RCRA requirements, see Section VI of this Notebook.

- **Characteristic Waste** - Even if waste does not appear on one of the hazardous waste lists, it still might be regulated as hazardous waste if it exhibits one or more of the following characteristics:

  — Ignitability. (40 CFR § 261.21) Ignitable wastes create fires under certain conditions, are spontaneously combustible, and have a flash point of less than 60°C (140°F), are ignitable compressed gas, or are an oxidizer (such as a chlorate or peroxide). The waste code for these materials is D001. They are liquids, other than aqueous solutions containing less than 24 percent alcohol by volume and with a flash point less than 60 ˚C (140 ˚F).

  — Corrosivity. (40 CFR § 261.22) Corrosive wastes are acids or bases that are aqueous and have a pH less than or equal to 2 or greater than or equal to 12.5; or are liquid capable of corroding

metal containers, such as storage tanks, drums, and barrels. A liquid is considered corrosive if it can corrode steel at a rate of at least 0.25 inches per year at 55° C (130° F). Wastes are aqueous if they contain 20 percent water, measured quantitatively or separated from the waste by pressure or vacuum filtration as described in EPA Method 1311. Note, waste that is not aqueous and contains no liquid falls outside the definition of EPA corrosivity. Examples include pharmaceutical compounding chemicals such as sodium hydroxide solution. The waste code for these materials is D002.

— Reactivity. (40 CFR § 261.23) Reactive wastes are unstable under normal conditions. They can cause explosions, toxic fumes, gases, or vapors when mixed with water. They can be a cyanide or sulfide-bearing waste that can generate fumes in a quantity sufficient to present a danger to human health when mixed with an acid or base. They may be capable of detonation or a forbidden explosive, or a Class A or Class B explosive, as defined in Department of Transportation regulations in 49 CFR Part 173. Examples include picric acid and lithium-sulfur batteries (such as those used in electronic thermometers). The waste code for these materials is D003.

— Toxicity Characteristic. (40 CFR § 261.24) Toxicity characteristic wastes are harmful or fatal when ingested or absorbed. When toxicity characteristic wastes are disposed of on land, contaminated rain or liquid may drain (leach) from the waste and pollute ground water. Toxicity is defined through a laboratory procedure called the Toxicity Characteristic Leaching Procedure (TCLP). Toxicity characteristic healthcare wastes include those exceeding regulatory values for chloroform, lindane, m-cresol, mercury and mercury compounds (thimerosal), and certain metals (such as arsenic). A number of other pesticides and solvents are also regulated under the TCLP rule. The waste codes for these materials range from D004 to D043. Research chemicals (TSCA exempt) do not always have toxicity data established for them. Most of the time these chemicals are incinerated as hazardous waste because not enough information is available. For mixed reagents, the toxic effects should be considered additive.

Highlighted below are eight hazardous waste types that are commonly used in healthcare facilities: mercury, chemotherapy and antineoplastic chemicals, formaldehyde, photographic chemicals, radionuclides, solvents, anesthetic gases, and toxic, corrosive, and miscellaneous chemicals.

- **Mercury** - The primary sources of mercury waste at most hospitals include:

  — Broken or obsolete medical equipment – sphygmomanometers, thermometers, tilt switches (e.g. in electric wheel chairs), intraocular pressure reducers (little bags of mercury used in past for eye surgery), esophageal dilators, cantor tubes, and miller abbott tubes.

  — Broken or obsolete components of facility equipment or capital medical equipment and/or calibration or process monitoring devices – manometers, barometers, oven and refrigerator thermometers, thermostats, mercury switches (tilt switches, reed switches, float switches), flow meters, flame sensors, boiler gauge controls, and fluorescent light bulbs. These can be found in pulmonary and blood gas labs, HVAC and facilities areas, laundry, kitchen, and laboratories as well as general areas.

  — Laboratory reagents and chemicals – as a preservative (e.g., thimerosol) or contaminant.

  — Plumbing – pipes and fittings, especially drain traps, can be contaminated with mercury because of spills that occurred in the past.

  Mercury wastes are decreasing in quantity due to the substitution of solid state electronic sensing instruments (thermometers, blood pressure gauges, etc.), and greater awareness of the hazards of mercury in the workplace. Mercury is also found as a preservative in many pharmaceuticals (thimerosal or phenylmercuric acetate); however, this is less common as awareness of the health and environmental hazards has increased. Finally, mercury has been identified as a "tramp" contaminant in a number of other common products including bleach. In these cases, the mercury is not intentionally added to the product.

- **Chemotherapy and Antineoplastic Chemicals** - Nine of the chemotherapy and antineoplastic drugs of concern from a waste perspective are on either the P or the U list of RCRA hazardous wastes, which was created in the 1970s. These are: Chlorambucil (Leukeran) (U035), Cyclophosphamide (Cytoxan, CTX, Neosar, Procytox) (U058), Daunomycin (Daunorubicin, Cerubidine, DaunoXome, Rubidomycin, Liposomal Daunorubicin) (U059), Diethylstilbestrol (Diethylstilbesterol, DES, Stilbestrol, Honvol, Stilbesterol) (U089), Melphalan (Alkeran, L-PAM) (U150), Mitomycin C (Mitomycin, Mutamycin) (U010), Streptozotocin (Streptozocin, Zanosar) (U206), Uracil Mustard (U237), and Arsenic Trioxide (Trisenox) (P012). Since that time, hundreds of new

formulations have come into the healthcare marketplace due to advances in pharmaceutical research. Some of these substances may have RCRA characteristics, which would place them in the hazardous waste category. It is important to note that not all chemotherapy medications are considered RCRA characteristic or listed wastes. However, because a single drug may have more than a dozen synonym names, determining collection and disposal methods for these drugs can be confusing and time-consuming. Healthcare facilities will need to determine the best collection method (e.g., maintain a list of RCRA characteristic or listed chemotherapy and antineoplastic drugs so that they may be collected and disposed of as RCRA waste or collect all chemotherapy and antineoplastic as RCRA waste) for their facility.

- **Formaldehyde** - Formaldehyde can be a significant source of hazardous waste at many hospitals. Formaldehyde (usually found in a dilute form called formalin) may be used in pathology, autopsy, dialysis, and in some nursing units. Formaldehyde is a U-listed waste that is regulated as an unused chemical product. Formaldehyde use in healthcare applications has diminished in recent years as greater understanding of the occupational risks and hazards has been recognized. In some cases, formalin that had been used to preserve specimens is discharged to the sewer. Healthcare facilities should determine if the spent formalin meets the definition of a characteristic waste (e.g. ignitability). Even if the waste is not hazardous, it is still a best management practice not to dispose of formalin down the drain, even if sanitation authorities allow such disposal. Some facilities that still use formalin in quantity have found that commercially available distillation and filtration technologies are cost-effective ways to reclaim reusable formalin. Additionally, some states may permit the use of formalin recycling units.

- **Photographic Chemicals** - Many healthcare facilities offer X-ray and radiology services. In the past, nearly all X-rays were developed using wet processing and chemicals. The photographic developing solutions used in X-ray departments consisted of two parts, a fixer and a developer. For facilities using the wet processing method for developing, the silver-containing effluent from the fixer solution is passed through a filter or is otherwise treated to recover this precious metal. The remaining aqueous waste, containing approximately 1.4 percent glutaraldehyde, 0.3 percent hydroquinone, and 0.2 percent potassium hydroxide, is typically discharged to the sewer. Discharges containing potentially regulated chemicals should be evaluated to determine if they contain hazardous waste, and if allowed by the POTW, approved for discharge in writing (See Section VI.A. RCRA Domestic Sewage Exclusion). Some hospitals utilize X-ray services that also provide silver recovery, through ion exchange or electrostatic techniques, as part of the customer service package.

Much has changed in radiology in the past decade. New films contain less silver and can be developed with dry processing. Digital imaging has taken the place of the standard X-ray. Many facilities are moving away from traditional radiology practice and going to a PAX-it brand system and digital X-rays. Facilities that have made this change have dramatically reduced the pollution outputs of fixer/developer and silver associated with films. New low-silver content films are also available on the market.

- **Radionuclides** - Radioactive wastes are generated in nuclear medicine and clinical testing laboratory departments. At some hospitals, short-lived radioactive materials in nuclear medicine are retained on site until they decay to nonhazardous levels. Depending on what the waste material is, it is then disposed of as solid or hazardous waste. For longer-lived radionuclides, storage times may be more limited and decay might only reduce the radionuclide to levels that can be more easily managed as low-level waste. Note that "mixed wastes" (defined by RCRA as low-level radioactive waste that is also hazardous) must be identified as such and disposed of properly. In cases where 'sharps' waste is associated with the radioactive material, such wastes are stored on site for proper decay, then disposed of as biohazardous waste once they are judged to be indistinguishable from natural background radiation.

- **Solvents** - Solvent wastes are typically generated by various activities throughout a hospital, such as pathology, histology, engineering, morgue, and laboratories. Volumes of solvent wastes generated at many hospitals are small. Specific solvents used in medical settings include halogenated compounds such as methylene chloride, chloroform, freon, trichloroethylene, and 1,1,1-trichloromethane. Other solvents include nonhalogenated compounds such as xylene, acetone, ethanol, isopropanol, methanol, toluene, ethyl acetate, and acetonitrile. Xylene, methanol, and acetone are the most frequently used solvents at many hospitals.

  Solvent waste (e.g., xylene, acetone, and methanol) are normally handled as hazardous waste. Some of these wastes are absorbed in tissue specimens, which are then treated instead as infectious wastes. Solvent wastes are typically stored in 30- or 55-gallon drums and can be recycled on site in solvent distillation units, or transported off site for recycling or for disposal as hazardous waste. Healthcare facilities should check with their state regulations before installing recycling units.

- **Anesthetic Gases** - Nitrous oxide, the halogenated agents halothane (Fluothane), enflurane (Ethrane), isoflurane (Forane), and other substances are used as inhalation anesthetics. Nitrous oxide is supplied as a gas in cartridges or cylinders that are attached directly to the anesthesia equipment. Used containers may be returned to the supplier. The

halogenated anesthetic agents are supplied in liquid form, in glass bottles. Once empty, the bottles and any residual must be properly disposed of.

Waste anesthetic gases are generally removed from the operating room, or the site of application, in one of two ways. At some larger hospitals, a scavenging unit is attached to the anesthesia unit to remove the waste gases. The scavenging unit may have a charcoal filter that absorbs halogenated anesthetic gases but not nitrous oxide. Spent charcoal filters are sent off site as hazardous waste. If there is no scavenging unit, or if the scavenging unit does not have a filter, then vacuum lines are used to collect waste anesthetic gases and vent them to the outside. These waste gases may cause air emission concerns.

- **Toxics, Corrosives, and Miscellaneous Chemicals** - Poisons, oxidizers, and caustics are used throughout most hospitals, generally in small quantities. Waste oils and solvents from maintenance may also be considered hazardous wastes as may some boiler water conditioning chemicals. Major toxic, corrosive, and miscellaneous chemical wastes include:

  — Sterilants (e.g., ethylene oxide),

  — Disinfecting cleaning solutions,

  — Utility wastes: boiler feed water treatment residuals (resin regeneration brine, spent resin), boiler blowdown, boiler cleaning (layup) wastes, cooling tower blowdown, and cooling tower sludges/sediments, and

  — Maintenance wastes: waste lube oils, vacuum pump oils, cleaning solvents, paint stripping wastes, and leftover paints and painting accessories.

Certain Pharmaceutical Waste

Pharmacies store and dispense medications and maintain a small inventory of chemicals for compounding purposes. Healthcare facilities routinely discard partial vials, IVs, and other unused drugs. In cases where medication formularies change, and unused pharmaceuticals accumulate, these items must be properly managed (see the discussion of reverse distribution below). In some cases, the items are RCRA listed or RCRA characteristic wastes. Some preparations of pharmaceuticals may also involve the use of solvents, which also may be RCRA hazardous waste. For these chemicals, disposal should follow the RCRA hazardous waste requirements explained in Section VI. Table III-1 lists more pharmaceutical wastes. For resources and more overview information refer to: *http://www.h2e-online.org/tools/chem-pharm.htm*

Reverse distribution is a product management strategy that allows pharmacies to return unused products to the manufacturer for potential credit, often through a reverse distributor. Pharmacies can remove pharmaceuticals that are not going to be used from their inventory, and quarantine them as a "product for return." The reverse distributor will either return them to the manufacturer for credit and final disposition or properly discard them if they cannot be used. (Note: It is not legal for a reverse distributor to redistribute outdated drugs, which are considered adulterated by FDA.) With this practice, unused/unexpired pharmaceuticals can be returned as product. This includes materials that have gone beyond the manufacturer's expiration date. Healthcare facilities should be careful not to use reverse distribution as a waste management strategy or as a means of avoiding proper disposal of waste (i.e., items that are obviously waste with no potential for reuse.) See the Returns Industry Association web page for more information: *http://www.returnsindustry.com*.

Commingled Waste

There are several examples of commingled wastes that need special consideration. These are wastes that include characteristics of different waste streams, that fall under different regulatory regimes, and pose special management concerns.

- **Commingled "biohazardous" and chemical wastes (e.g., tissue soaked in formalin)** - Many tissue samples are kept by healthcare institutions, labs, and research facilities in containers of formalin or formaldehyde. As a commingled waste, management techniques should be applied to separate the substances, as appropriate, and properly characterize, treat, and dispose of the residuals.

- **Mixed radioactive wastes** - Many healthcare facilities generate low-level radioactive waste as a by-product of administrating radiopharmaceuticals, radioimmunology, and nuclear medicine procedures. Contaminated materials may include solid wastes, biohazardous wastes, and chemical wastes. For healthcare facilities, low-level waste includes clothing, linens, cleaning materials, medical tubes, swabs, injection needles, syringes, and laboratory animal carcasses and tissues that came into contact with radioactivity. To manage low-level radioactive waste, hospitals normally store materials on site, either until the materials are no longer radioactive (and can be handled as municipal solid waste (MSW) or state Regulated Medical Waste (RMW)), or until enough material has accumulated for transfer to a proper disposal facility. If the low-level radioactive waste is mixed with a hazardous waste, it meets the RCRA definition of a "mixed waste" and cannot be disposed of as MSW or RMW. Separating the hazardous and nonhazardous radioactive wastes prior to decay storage will help prevent hazardous waste from entering the solid waste stream during post-decay disposal.

- **Commingled nonhazardous and hazardous wastes** - EPA's "Mixture Rule" states that mixtures of solid waste and listed hazardous waste must

be regulated as hazardous waste. There are two ways to determine if a material is regulated under the mixture rule: (1) if the material is a mixture of a solid waste and a hazardous waste, and the mixture exhibits one or more of the characteristics of hazardous waste; or (2) if the material is a mixture of a solid waste and a listed waste. The mixture rule is intended to discourage generators from mixing wastestreams.

However, the mixture rule does have a number of exemptions for wastewaters that are subject to the Clean Water Act [see 40 CFR 261(a)(2)(iv)]. One exemption is for laboratory wastewater that either (1) does not exceed one percent of the total wastewater flow, or (2) has an average concentration of toxic constituents less than one part per million.

Pressurized Containers and Ignitable Compressed Gas

Pressurized containers sometimes use a flammable propellant (the can is labeled "Flammable"), in which case they are hazardous waste (D001, ignitable). Ignitable compressed gas is also hazardous waste (D001). Healthcare facilities should dispose of these as D001 waste.

Some examples of pressurized containers and ignitable compressed gas include:

- Oxygen gas cylinders;
- Liquid nitrogen cylinders;
- Ethyl chloride (chloroethane); and
- Fluoro-ethyl (25 percent ethyl chloride, 75 percent dichlorotetrafluorethane).

In addition, propellants may contain chlorofluorocarbons (CFCs), which may be F- or U-listed hazardous wastes. CFC-containing wastes should be managed separately from incineration wastes. Finally, large quantities of aerosols should be stored in a secure, fire-safe area to prevent fire hazards.

Universal Waste

Under a special provision of RCRA, universal waste is exempted from Subtitle C requirements and are regulated under the Universal Waste Rule (40 CFR §273). There are four types of universal waste: batteries containing hazardous substances (e.g., lead, acid, nickel, or cadmium), pesticides containing RCRA hazardous components that are recalled or sent to a collection program, mercury-containing thermostats, and spent fluorescent lamps and other hazardous lamps (e.g., with mercury or lead). Note that many states manage their own universal waste programs and many have included electronic wastes in their universal waste programs.

EPA created the Universal Waste Rule (40 CFR §273) in May 1995. Universal waste labeling and storage requirements are less stringent than for hazardous waste. This allows hospitals to more easily recycle batteries, thermostats, and fluorescent lamps. However, hospitals must still comply with special requirements for labeling, storage, and manifesting. More specific information can be found at the EPA web site: *http://www.epa.gov/epaoswer/hazwaste/id/univwast.htm* More information on management of universal wastes at hospitals can be found at: *http://www.h2e-online.org/tools/univwast.htm*

III.B.4. Wastes by Media Category

Hospitals generate several types of media-specific wastes, as described below.

Wastewater

Healthcare facilities wastewater sources include:

- Sinks, floor drains, showers, toilets, dish and laundry washing machines, and tubs;
- Photographic development drains from radiology (X-rays), other imaging, and dentists; and
- Stormwater.

A large healthcare facility contains thousands of drains. Proper drain disposal practices should be in place in each area. Most facilities discharge sink, shower, toilet, and tub wastewater to POTWs, known as indirect discharge. Some facilities may discharge this wastewater directly to surface water, known as direct discharge. All drains that discharge directly should be given special consideration to ensure that no hazardous chemicals are being sent down the drain. Photographic development (X-ray) wastewater is generally filtered to recover silver before it is discharged. Section VI discusses the Clean Water Act (CWA) regulatory requirements for stormwater and direct and indirect discharges from healthcare facilities. Mechanical shop floor drains should drain to a POTW and not simply empty into the soil. Drains that empty to the soil would be considered a Class V Injection Well, which would require a permit under the Underground Injection Control Program of the Safe Drinking Water Act.

EPA conducted a Preliminary Data Summary[8] on hospitals in 1989 and sampled four hospitals. Although five pollutants were detected at levels higher than expected for municipal wastewater (e.g., silver, phenols, barium, acetone, and mercury), the discharge concentrations of these pollutants were determined to be low enough that they would not cause pass-through or interference at POTWs.

[8] EPA, 1989. *Preliminary Data Summary for the Hospital Point Source Category*, EPA-440-1-89-060-n, September 1989.

Healthcare facilities generate stormwater from building and parking lot areas or from aboveground or underground oil or fuel storage tank areas. Hospitals with construction areas of one acre or larger need stormwater permits. Public hospitals in urban areas may discharge to municipal separate storm sewer systems (MS4s) and must also comply with stormwater regulations, as discussed in Section VI of this Notebook.

Healthcare facilities with underground storage tanks (USTs) or aboveground storage tanks (ASTs) need to consider the Oil Pollution Prevention requirements (discussed in Section VI of this Notebook). Facilities with fleet vehicles, such as ambulances, may keep fuel or oil in USTs or ASTs and may also have USTs for on-site diesel generators.

The management of unused prescription drugs may involve oversight by state and local governments and several federal agencies, including the EPA. The Agency does not currently have specific regulations regarding the disposal of expired or waste prescription medications into sanitary sewer systems, nor does EPA's Office of Water have analytical methods to assess the existence of many pharmaceutical compounds in water or wastewater. The Agency, however, is aware of increasing concerns about the potential for pharmaceuticals in water and is reviewing the current state of knowledge and coordinating with other governmental and research agencies.

Air Emissions

At hospitals, air emissions come from air conditioning and refrigeration, boilers, medical waste incinerators (if on site), asbestos, paint booths, ethylene oxide sterilization units, emergency generators, anesthesia, laboratory chemicals, and laboratory fume hoods.

Hospital/medical/infection waste incinerators (HMIWI) are used by hospitals, healthcare facilities, and commercial waste disposal companies to burn hospital waste and/or medical/infectious waste. When burned, hospital waste and medical/infectious waste may emit various air pollutants, including hydrochloric acid, dioxin/furan, and the toxic metals lead, cadmium, and mercury (as discussed in Section IV.C of this Notebook).

III.C. Assessment of Wastes Generated by Functional Activity

Table III-2 identifies 18 key functions and major activities that are likely to be found within health sector institutions. The chart can be used to identify the types of EPA regulated wastes likely to be found and the areas in which they would be generated.

Table III-2: Healthcare Facility Wastes

Functional Activities	Wastes Produced
Administrative Activities and Services • Offices • Billing services • Medical records • Public relations/marketing • Nursing care documentation • Human resources • Security • Social services/care management • Retail services • Shipping and receiving • Printing/copying	• Municipal solid waste from all service areas • Batteries from cell phones, special pagers, PDAs, digital cameras, and communication devices • Mercury-containing switches from greeting cards and other 'gifts' in the gift shop • Solvents possibly associated with a print shop • Oils from a printing press • Toner cartridges from copiers and printers • Cleaning chemicals associated with retail establishments • Kitchen grease associated with retail food establishments • Wastewater from retail services
Support Services • Information services • Food services • Laundry services • Pharmacy • Central sterile reprocessing • Biomedical engineering	• Municipal solid waste from all service areas • Biohazardous waste from laundry services and central sterile reprocessing • Electronics/computer wastes (CRTs, hard drives) from information services, and biomedical engineering • Chemicals associated with cleaning, laundry, and food services (decalcifiers, degreasers, chlorine bleach) • Pesticides associated with cleaning services or food services • RCRA listed and RCRA characteristic pharmaceuticals from the pharmacy • EtO from central sterile reprocessing • High-level disinfecting agents associated with central sterile reprocessing • Cleaning chemicals • Peracetic acid from central sterile reprocessing • Batteries (nicad, lithium, mercuric oxide, and others) from biomedical engineering • Kitchen grease from food services • Degreasers, solvents from food services or laundry • Mercury-containing devices such as thermometers in refrigerators, incubators, and heating units • Wastewater from all service areas including food services and laundry services • Air emissions from laundry services, refrigeration, and sterilization • Sharps waste from the pharmacy, central sterile, and from accidental disposal in laundry and food service

Table III-2: Healthcare Facility Wastes (Continued)

Functional Activities	Wastes Produced
Facilities Management, Engineering and Maintenance, and Plant Operations Housekeeping • Maintenance shops (paint, electric, plumbing) • Heating Ventilation and Air Conditioning (HVAC) • Waste treatment • Water treatment • Fleet management • Grounds keeping • Pest management	• Municipal solid waste from all facility areas • Air emissions from boilers • Cleaning chemicals • Chemicals associated with paint shop - turpentine, strippers, solvents, adhesives • Chemicals associated with electric and plumbing shop including oils, adhesives • Chemicals associated with air handling system • Chemicals associated with water treatment systems (decalcifiers, disinfecting solutions) • Radioactive or mixed waste residues in water treatment system, drains and piping • Chemicals associated with elevator care and maintenance (hydraulic fluids) • Chemical associated with groundskeeping and pest management • Mercury-containing switches, manometers, pressure gauges, fluorescent lamps, and thermostats • PCB-containing fluorescent light ballasts and electrical transformers • Asbestos • Pressurized gas canisters/containers from all facility areas • Wastewater from drains, water treatment, and fleet management • Air emissions from HVAC systems and maintenance shops (paint booths)
Laboratory Services • Hematology • Microbiology • Chemistry • Blood Bank • Surgical Pathology • Histology	• Municipal solid waste from all service areas • Biohazardous waste from all service areas • Mixed biohazardous wastes • Chemicals associated with laboratory testing including: alcohols, xylene, toluene, formaldehyde, b5 fixatives, picric acid, other acids and bases chemicals, and cleaning solutions (see chemical inventory in each laboratory area to identify RCRA listed and characteristic wastes) • Mercury-containing devices such as calibration manometer, water bath thermometer, incubator and refrigerator thermometers • Cleaning chemicals • Radioactive or mixed waste residues • Pressurized gas cylinders (blood gas analysis area) • Wastewater from sinks and drains • Air emissions from laboratory chemicals and hoods

Table III-2: Healthcare Facility Wastes (Continued)

Functional Activities	Wastes Produced
Diagnostic Services • Endoscopy • Cardiac Catherization lab • Radiology (CT, MRI, digital imaging) • Nuclear medicine • Sleep studies (EEG)	• Municipal solid waste from all service areas • Biohazardous waste from all service areas • Mixed waste from tissue samples and chemical, or radioactive and solid, or radioactive and chemical • Glutaraldehyde or other disinfectant/cleaner associated with endoscopy • RCRA listed and RCRA characteristic pharmaceuticals • Formalin for tissue samples obtained from any of the listed diagnostic services • Silver from radiology films, fixer and developer • Radioisotopes from nuclear medicine • Collodion (ether/alcohol) from EEG areas • Cleaning chemicals • Lead shielding from radiology • Wastewater from sinks and drains and photographic developing • Air emissions from sterilization and disinfection
Surgical Services • Ambulatory outpatient services • Surgery • Post-anesthesia care • Preoperative services • Anesthesia	• Municipal solid waste from all service areas • Biohazardous waste from all service areas • Mixed waste from tissue samples • RCRA listed and RCRA characteristic pharmaceuticals • Mercury-containing monitoring equipment (thermometers, sphygmomanometers, and esophageal dilators) • Used batteries (Nicad, lithium, other) • Waste anesthetic gases and compressed gas cylinders • Cleaning solutions; high-level disinfectants • Phenol • Collodion • Formalin • If surgical pathology unit is present in surgical services area, look for xylene, toluene • Wastewater from sinks and drains • Air emissions from anesthetic gases
Inpatient Care Services • Medical surgical care • Orthopedic care • Neurology care • Urology care • Cardiac care • Psychiatric/behavioral health • Geriatric care • Palliative care • Maternal child care (labor and delivery/birthing, postpartum care, nursery, pediatrics) • Pediatric care • Cancer care • Rehabilitative care	• Municipal solid waste from all service areas • Biohazardous waste from most service areas • RCRA listed and RCRA characteristic pharmaceuticals • Mercury-containing monitoring equipment (thermometers and sphygmomanometers) • Cleaning solutions; high-level disinfectants • Chemicals related to leatherwork, plastic casting, etc. for rehabilitation/prosthesis device producing settings • Wastewater from sinks and drains • Air emissions from sterilization and disinfection

Table III-2: Healthcare Facility Wastes (Continued)

Functional Activities	Wastes Produced
Critical Care Services • Surgical intensive care • Medical intensive care • Pediatric intensive care • Cardiac intensive care • Burn care • Neonatal intensive care	• Municipal solid waste from all service areas • Biohazardous waste from all service areas • RCRA listed and RCRA characteristic pharmaceuticals • Mercury-containing monitoring equipment (thermometers and sphygmomanometers) • Used batteries (Nicad, lithium, other) • Cleaning solutions; high-level disinfectants • Wastewater from sinks and drains • Air emissions from sterilization and disinfection
Emergency Care Services	• Municipal solid waste from all service areas • Biohazardous waste from all service areas • RCRA listed and RCRA characteristic pharmaceuticals • Mercury-containing monitoring equipment (thermometers, sphygmomanometers, and especially hypothermia thermometers) • Chemical or biological agents from decontamination (chemical/biological) area for incoming patients • Waste anesthetic gases and compressed gas cylinders • Cleaning solutions; high-level disinfectants • Formalin • Silver from radiology films, fixer and developer • Lead shielding from radiology • Wastewater from sinks and drains, ensure that decontamination area drains connect to containment tank for potentially hazardous fluids. • Air emissions from sterilization and disinfection, ensure that decontamination area ventilation system connects to filter or separate system for potentially hazardous pollutants
Respiratory Care Services • Pulmonary function testing • Oxygen therapies	• Municipal solid waste from all service areas • RCRA listed and RCRA characteristic pharmaceuticals • Mercury-containing monitoring equipment (thermometers and sphygmomanometers) • Compressed gas cylinders (oxygen tank management) • Used batteries • Cleaning solutions; high-level disinfectants • Wastewater from sinks and drains • Air emissions from sterilization and disinfection
Dialysis • Hemodialysis • Peritoneal dialysis	• Municipal solid waste from all service areas • Biohazardous waste from all service areas • RCRA listed and RCRA characteristic pharmaceuticals • Mercury-containing monitoring equipment (thermometers and sphygmomanometers) • Formaldehyde, formalin • Cleaning solutions; high-level disinfectants • Wastewater from sinks and drains

Table III-2: Healthcare Facility Wastes (Continued)

Functional Activities	Wastes Produced
Physical Therapy Occupational Therapy	• Municipal solid waste from all service areas • Mercury-containing monitoring equipment (thermometers and sphygmomanometers) • Cleaning solutions • Chemicals related to leatherwork, plastic casting, etc. for rehabilitation/prosthesis device producing settings • Wastewater from sinks and drains
Outpatient Services (Nonsurgical) • Womens' health/gynecology • General medicine • Family practice • Specialty clinics (orthopedics, urology, pulmonology, allergy) • Pediatrics • Rehabilitative services	• Municipal solid waste from all service areas • Biohazardous waste (mostly sharps) • RCRA listed and RCRA characteristic pharmaceuticals from sample medications • Mercury-containing monitoring equipment (thermometers and sphygmomanometers) • Cleaning solutions; high-level disinfectants • Wastewater from sinks and drains
Oncology/Cancer Care Services • Radiation oncology • Chemotherapy • Lead molds - Cerrobend	• Municipal solid waste from all service areas • Biohazardous waste • RCRA listed and RCRA characteristic pharmaceuticals • Mercury-containing monitoring equipment (thermometers and sphygmomanometers) • Chemotherapy waste - RCRA listed and RCRA characteristic • Chemotherapy waste - non-RCRA regulated • Mixed radioactive and hazardous waste • Radioisotopes from nuclear medicine • Cleaning solutions; high-level disinfectants • Wastewater from sinks and drains
Dentistry • Oral surgery • Periodontics • Oral healthcare	• Municipal solid waste from all service areas • RCRA listed and RCRA characteristic pharmaceuticals • Waste anesthetic gases and compressed gas cylinders • Residual mercury amalgam • X-Ray materials; lead shields • Cleaners, disinfectants • Wastewater from sinks and drains • Air emissions from sterilization and disinfection • Biohazardous and sharps waste
Animal Research and Testing	• Municipal solid waste from all service areas including animal care • Biohazardous waste from all service areas • RCRA listed and RCRA characteristic pharmaceuticals • Mercury-containing monitoring equipment (thermometers and sphygmomanometers) • Research chemicals • Radioactive or mixed waste residue • Wastewater from sinks and drains • Air emissions from laboratory chemicals and hoods, and from sterilization and disinfection

Table III-2: Healthcare Facility Wastes (Continued)

Functional Activities	Wastes Produced
Clinical Research	• Municipal solid waste from all service areas • Biohazardous waste from all service areas • RCRA listed and RCRA characteristic pharmaceuticals • Mercury-containing monitoring equipment (thermometers and sphygmomanometers) • Research chemicals • Wastewater from sinks and drains • Air emissions from laboratory chemicals and hoods, and from sterilization and disinfection
Construction and Renovation	• Municipal solid waste from all service areas • Mercury-containing monitoring equipment (thermometers and sphygmomanometers) • PCB-contaminated light ballasts • Asbestos • Radioactive or mixed waste residue in drains and piping • Stormwater • Lead paint

III.D. Management of Waste Streams

Healthcare facilities may treat, recycle, or dispose of the waste streams that they produce. This subsection presents some examples of management techniques (and example waste types). This is not meant to be a comprehensive list, but an introduction only; refer to the sources at the end of this Notebook for more detail.

EPA ranks options for managing waste in descending order of preference. This ranking encourages reliance on those approaches that minimize the generation of waste and environmental releases. SOURCE REDUCTION is assigned the highest priority because it emphasizes eliminating or reducing wastes at the point of generation. Purchasing a digital thermometer, rather than one containing mercury, for example, reduces the heavy metal content in the waste and reduces the need for recycling, treatment, or disposal. Source reduction is typically less expensive than collecting, treating, and disposing of waste. It also reduces risks for workers, the community, and the broader environment.

REUSE is the next preferred option. Implementing measures to reuse products and packages for their original purpose reduces purchasing costs and packaging wastes as well as wastes from patient care activities. Healthcare facilities find that reusable linens, reusable patient supplies, such as bedpans and emesis basins, as well as reusable dishes and cutlery for food service are generally economically and environmentally preferable to their disposable counterparts, although there are costs incurred in cleaning and sterilizing equipment for reuse.

RECYCLING encourages regenerating materials or reclaiming constituents of the waste stream into usable items. Paper and paper products, such as corrugated cardboard, glass food and beverage containers, metals, and certain plastics may be recyclable. However, facilities

should evaluate the local environmental and economic consequences associated with collecting and recycling materials as well as the associated energy and resource costs.

TREATMENT to reduce the volume or the potentially harmful environmental impacts of the waste is ranked at the lower end of the hierarchy. Medical waste treatment technologies include autoclaving, hydropulping, pyrolysis, microwave, incineration, chemical treatment, and irradiation. Treatment precedes disposal, the least favored option. Ultimately, however, some wastes and medical waste treatment residues require land disposal. The costs of treatment and disposal are significant, and both have inherent environmental impacts, including emissions to air and water.

Reduction/Prevention

The amount of almost all wastes produced through healthcare activities can be reduced. This can be as easy as a manufacturer using less packaging or replacing corrugated shipping containers with reusable totes. It can also mean not using certain materials (e.g., mercury) that become problematic wastes, through a technique called Environmentally Preferable Purchasing (EPP). This technique can be used by the purchasing agency for any healthcare facility. For more information regarding EPP go to *http://www.epa.gov/opptintr/epp/*.

Waste can also be prevented through vendor return programs, which encourage product stewardship. A common program is returning cartridges from printers and copiers. Many healthcare facilities are now signing contracts for computers and peripherals that require the vendor to take back units when new units are purchased. There is also a "returns" industry for pharmaceuticals that takes back unused pharmaceuticals as product, not waste.

Segregation

As wastes are generated, the most important management technique to ensure worker safety, ensure proper treatment and disposal, and minimize environmental risk, is to strictly segregate wastes. The general principle is to segregate wastes so that most of the waste ends up in categories that can be reused, recycled, or that are safer and cheaper to dispose of (e.g., municipal solid waste). The principle of segregation is most commonly used to reduce the generation of biohazardous wastes, to ensure that only those wastes truly contaminated or posing a risk are placed in "red" bags or sharps containers. This principle is also very important when considering separating wastes for recycling and for management of chemical wastes.

Reuse

Common chemicals (xylene, formalin, alcohol) used in some activities can be reprocessed and reused. Newer technologies have made this option safer and more affordable.

A number of common medical devices have now been designed for reprocessing and reuse (e.g., pulse oximeters). Numerous other reusable items can be used in healthcare activities including linens, gowns, drapes, bedpans, dishware, utensils, and cutlery.

Recycling

Much of the municipal solid waste generated from healthcare activities is easily recyclable, when one considers that up to 40-50 percent of the waste from most activities is paper and cardboard. Another large portion consists of other commonly recycled metals, plastics and glass. Aggressive recycling programs can divert a very large portion of waste from healthcare activities.

Pressurized containers, universal wastes, and construction and demolition debris are also commonly recycled materials generated at healthcare institutions.

Composting

Some hospitals have identified options for segregating and disposing of food waste and landscaping discards at authorized composting operations.

Landfill

Waste from healthcare activities that is classified as municipal solid waste is often sent to a landfill for final disposal. In some states or tribal regions, untreated biohazardous wastes may be sent to landfills under special conditions. Proper segregation is important to keep hazardous materials from being disposed of in landfills, many of which have specific bans on such items.

Incineration (Off-site Municipal Plant)

Waste from some healthcare activities classified as municipal solid wastes may be sent to a municipal solid waste incinerator. The waste ash will then have to be disposed of as either municipal solid waste or hazardous ash depending on testing. A key issue in the incineration of healthcare wastes is that the municipal solid waste stream from healthcare tends to be rich in PVC plastics, which when combusted can produce dioxins.

Medical Waste Incinerator (On-site or Off-site)

Depending on state or tribal regulation, at least a small portion of biohazardous waste, including sharps, may have to be incinerated. This will likely include pathological wastes and wastes contaminated with small amounts of chemotherapy substances. The incineration of large amounts of biohazardous wastes has decreased in the United States, due to concerns over emissions and the implementation of the EPA air emission regulations for Hospital/Medical/ Infectious Waste Incinerators (HMIWI). Most treatment has moved to other noncombustion technologies.

Noncombustion Biohazardous Treatment Technologies (e.g., Autoclave/ Microwave Treatment/Chemical Mechanical Treatment) (On-site or Off-site)

The majority of biohazardous wastes is now being treated using noncombustion technologies. More than 40 certified noncombustion treatment technologies are in use or being tested in the United States. These devices use heat and pressure or chemicals to render the wastes generally noninfectious and suitable for disposal in landfills.

Hazardous Waste Treatment Facilities, Incinerators, Landfills

Of the wide variety of hazardous materials generated through healthcare activities, some will have to be packaged and transported for special treatment and disposal at specialized licensed facilities to manage hazardous waste. These range from waste oils to toxic chemicals such as phenol.

Treatment at POTWs

Many wastes, from body fluids, to kitchen food scraps, to a wide mix of chemicals, cleaners and disinfectants are discharged to the wastewater system, and must be managed by a POTW. Stormwater run-off from facilities may also have to be discharged to these treatment plants or to a municipally maintained stormdrain network. Local and state regulations may specifically require pollutant prevention measures, waste segregation, and/or treatment of these waste streams prior to discharge.

Treatment/Control On-site

A variety of technologies to pretreat wastewater and various air emissions (e.g., ethylene oxide) have been used at healthcare facilities to reduce direct emissions.

IV. WASTE AND EMISSIONS PROFILE

This section provides information on the volume of waste released by the healthcare industry. The Toxics Release Inventory (TRI) is a publicly available EPA database that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. Because only federal facilities in the healthcare industry are required to report pollutant release and other waste management information to TRI, little quantitative waste information is available for this sector. The data provided in this section are for hospitals, the segment of the healthcare industry for which the most data are available.

IV.A. Solid, Biohazardous, and Hazardous Waste Production Data for the Healthcare Industry

According to the information published in the SHEA[9] position paper on medical waste, the United States healthcare industry generates 6,670 tons per day of waste, most of which is solid or municipal waste. In January 1992, it was estimated that approximately 15 percent of this waste was infectious waste, or about 1,000 tons per day. A small fraction of healthcare waste is hazardous chemical or radioactive waste.

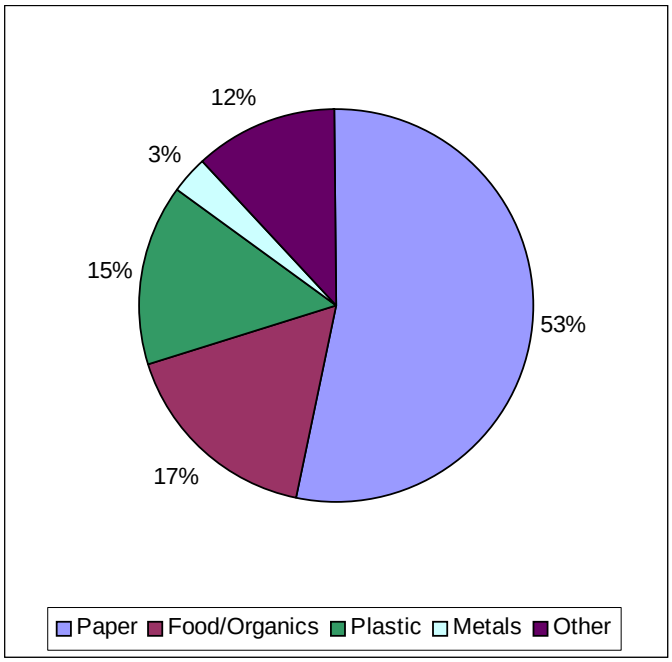
There have been limited studies evaluating healthcare waste comprehensively. Those studies were often conducted in preparation for a waste treatment technology, or were conducted on a small segment of healthcare wastes. Healthcare waste has continued to shift qualitatively as medical advances have occurred, changing the nature of many procedures, and thus wastes, within the industry. Laparoscopic procedures, cautery devices, and laser surgery have all contributed to procedures that generate less biological waste. Advances in pharmaceutical technology have reduced the need for surgical interventions. Adjustments in healthcare reimbursements have contributed to decreased length of stay in hospitals and increases in home care and outpatient or ambulatory healthcare. The supply industry has streamlined many aspects of product packaging, and the use of plastics instead of glass has lessened the weight of many products. Medical waste definitions vary from state to state, which can impact the waste segregation programs set up in a given facility.

IV.A.1. Municipal Solid Waste

Of the approximately 3.4 billion pounds of solid waste produced annually by hospitals, more than half is composed of paper and cardboard. Figure IV-1 demonstrates the composition of hospital solid waste.

[9] Rutala WA, Mayhall CG, "The Society for Hospital Epidemiology of American (SHEA) Position Paper: Medical Waste." *Infection Control Hospital Epidemiology*. 1992; 13:38-48.

Figure IV-1: Hospital Solid Waste Composition



Source: Healthcare Without Harm, "Setting Healthcare's Environmental Agenda" Conference Proceedings: Waste Management White Paper.

Much of the waste that is considered municipal solid waste (MSW) is composed of corrugated cardboard, paper, glass, plastics, wood, metals, food waste, leaf and yard waste, and a variety of mixed materials. For hospitals in areas that have community infrastructures to support recycling, up to 40 percent of the solid waste can be recyclable. Other wastes that can also be recycled include kitchen grease, durable goods (furnishings), toner cartridges, and X-ray film.

IV.A.2. Biohazardous Waste

As stated above, in January 1992, it was estimated that approximately 15 percent (an estimated 1,000 tons per day) of hospital waste was infectious waste. Biohazardous waste, also referred to as infectious waste or regulated medical waste, is that component of healthcare waste that includes sharps, pathological waste, blood and blood products, blood-soaked items, and non-regulated chemotherapy waste.

In evaluating biohazardous waste handling, it is important to understand the distinctions between state EPA biohazardous waste definitions, which help define this category of waste for treatment and disposal, and Universal Precautions, an OSHA blood-borne pathogens (BBP) rule, which is designed to protect workers from exposure to blood-borne diseases. The OSHA BBP rule provides guidance on the use of personal protective equipment when caring for patients, and has requirements for labeling and handling biohazardous waste, along with other types of waste.

It is not uncommon for workers in a healthcare facility to refer to biohazardous waste as contaminated trash, infectious waste, medical waste, medical infectious waste, regulated medical waste, or some other similar term. From a regulatory perspective, this waste stream should be collected in a consistent manner, with sharps being segregated at the source of generation in leakproof, puncture-resistant containers, and other regulated medical waste collected in biohazard containers or bags. Pathological wastes, or tissue waste, are also considered biohazardous waste, and should be collected and labeled for disposal via incineration (or as otherwise regulated by the state). Nonregulated chemotherapy wastes are also collected in distinctive containers with the chemotherapy label, packaged for disposal along with biohazardous waste, and labeled for incineration only (or other technologies that may become available).

IV.A.3. Hazardous Chemical Waste

The healthcare industry is not required to report pollutant release and other waste management information to the TRI. Therefore, little quantitative hazardous chemical waste generation information is available for this sector. However, healthcare facilities tend to generate small quantities of various hazardous chemicals relative to the amount of municipal solid waste or biohazardous waste. The amount and type of hazardous chemical waste generated is directly related to the type of facility and the quantity of various products used.

Hazardous chemical waste generation is related to key functions within the healthcare sector. These include laboratory testing areas, facility maintenance areas, groundskeeping areas, and some diagnostic areas. Facilities that include research units usually generate greater volumes and more diverse hazardous chemicals. A small amount of pharmaceuticals commonly in use are also listed or characteristic RCRA wastes. EPA has found that most hospitals tend to be small quantity generators unless they are part of a large facility, such as a university or military base, in which case they tend to be large quantity generators. Facilities may also be temporarily large quantity generators when disposing of waste chemicals during laboratory cleanouts.

IV.B. Wastewater Discharge Data for the Healthcare Industry

A majority of healthcare facilities discharge wastewater to POTWs. These facilities complete discharge monitoring reports (DMR) according to their state, tribal, and local water discharge guidelines, but there is not a centralized data collection system for the information.

Facilities that discharge directly to waters of the United States are considered direct dischargers. Effluent discharge data from these facilities are collected in EPA's Permit Compliance System (PCS). According to calendar year 2000 data from PCS, there are only three major dischargers in the healthcare industry. Dischargers are classified as major based on an assessment of six characteristics: (1) toxic pollutant potential; (2) flow/stream flow volume; (3) conventional pollutant loading; (4) public health impact; (5) water quality factors; and (6) proximity to nearby coastal waters.

The database includes data for only a limited set of minor dischargers when the states choose to include these data. As a consequence, extensive data are not available for minor dischargers in PCS; data for 103 minor direct dischargers are in PCS.

The 106 direct dischargers in healthcare that are included in PCS fall into the categories in Table IV-1 (note that PCS uses Standard Industrial Classification (SIC) codes).

Table IV-1: Direct Dischargers Included in PCS

SIC Code	SIC Description	Minor Dischargers	Major Dischargers
8011	Offices & Clinics of Medical Doctors	4	0
8021	Outpatient Care Facilities	2	0
8051	Skilled Nursing Care Facilities	21	0
8052	Intermediate Care Facilities	18	0
8059	Nursing and Personal Care, NEC	18	0
8062	General Medical & Surgical Hospitals	20	2
8063	Psychiatric Hospitals	7	1
8069	Specialty Hospitals, Except Psychiatric	4	0
8071	Medical Laboratories	3	0
8082	Home Health Care Services	1	0
8092	Kidney Dialysis Centers	1	0
8099	Health & Allied Services, NEC	4	0
	Total	**103**	**3**

Source: PCS 2000 data.

Table IV-2 provides the total pounds of pollutants discharged annually by these 106 facilities. The totals shown are a result of summing the pounds per year contained in the PCS 2000 data. Note that only annual discharges of one pound or greater are shown.

Table IV-2: Pollutant Discharge from Direct Discharging Healthcare Facilities

Parameters	Pounds Per Year
Solids, Total Dissolved	8,065,304
Oxygen, Dissolved (DO)	822,943
Phosphorus, Total (As P)	739,632
Solids, Total Dissolved- 180 Deg. C	430,840
Oil & Grease Freon Extr-grav Meth	300,913
Solids, Total Dissolved (TDS)	199,682
Chloride (As Cl)	190,842

Table IV-2: Pollutant Discharge from Direct Discharging Healthcare Facilities (Continued)

Parameters	Pounds Per Year
Solids, Total Suspended	100,996
BOD, 5-day (20 Deg. C)	36,244
BOD, Carbonaceous 05 Day, 20C	20,821
Sulfate (As S)	15,504
Nitrogen, Ammonia Total (As N)	10,061
Hardness, Total (As CaCO3)	7,796
Oxygen Demand, Chem. (Low Level) (Cod)	4,961
Chlorine, Total Residual	1,374
Nitrogen, Total (As n)	730
Nitrite Plus Nitrate Total 1 Det. (As N)	632
Nitrogen, Nitrate Total (As N)	547
Nitrogen, Kjeldahl Total (As N)	413
Carbon, Tot Organic (TOC)	205
Oxygen Demand, Chem. (High Level) (COD)	176
Sulfide, Total (As S)	106
Magnesium, Total (As Mg)	77
Bromine Chloride	40
Zinc, Total (As Zn)	30
Fluoride, Total (As f)	16
Copper, Total (As Cu)	9
Hydrocarbons, in H2O, IR, CC14 Ext. Chromat	4
Surfactants (MBAS)	3
Zinc Total Recoverable	2
Copper Total Recoverable	2
Silver, Total (As Ag)	1

Source: PCS 2000 data.

IV.C. Air Emissions from the Healthcare Industry

Hospitals generate air emissions from medical waste incinerators, boilers, sterilization chemicals, air conditioning and refrigeration, and laboratory fume hoods. Air emissions data for certain pollutants are available from the National Emission Trends (NET) database (1999), and hazardous air pollutant emissions data are available from the National Toxics Inventory (NTI) database (1996). These databases have since been replaced by the National Emission Inventory database, but no final data are yet available. For the SIC codes

80xx (Health Services), the total emissions for volatile organic compounds (VOC), nitrogen oxides (NO_x) and hazardous air pollutants (HAPs) are shown in Table IV-3.

Table IV-3: Total Emissions for VOC, NOx, and HAPs (Tons/Year)

SIC Code	SIC Description	VOC	NOx	HAP
8011	Offices and Clinics of Medical Doctors	7	74	5
8051	Skilled Nursing Care Facilities	16	88	0
8052	Intermediate Care Facilities		1	5
8059	Nursing And Personal Care, NEC	9	228	0
8061	Hospitals	0	6	
8062	General Medical & Surgical Hospitals	1,204	12,440	607
8063	Psychiatric Hospitals	115	3,412	53
8069	Specialty Hospitals, Except Psychiatric	53	760	31
8071	Medical Laboratories	17	15	15
8081	Outpatient Care Facilities (1977)		0	
8082	Home Health Care Services			1
8092	Kidney Dialysis Centers	2	126	0
8093	Specialty Outpatient Clinics, NEC	0	2	
8099	Health And Allied Services, NEC	16	68	14
8050	Nursing and Personal Care Facilities	0	4	
	Total, All Health Services Subsectors	1,445	17,429	731

Source: Environmentally Conscious Manufacturing Strategic Initiative Group at the National Center for Manufacturing Sciences (NCMS).

Incinerator Emissions

In the September 15, 1997 Federal Register Notice (FRN) for the Hospital/ Medical/Infectious Waste Incinerators (HMIWI) Final Rule, EPA identified approximately 1,139 small HMIWI, 692 medium HMIWI, 463 large HMIWI, and 79 commercial HMIWI in operation. EPA estimated that, as a result of the final rule, 93 to 100 percent of small ''nonremote'' HMIWI, 60 to 95 percent of medium HMIWI, and as many as 35 percent of large HMIWI would cease operation. All 79 commercial units and 114 small units meeting the ''remote'' criteria were assumed to remain in operation. Facilities that ceased operation were assumed to find alternate methods of waste disposal.

As a result of the HMIWI rule, most facilities have phased out their on-site incinerators. Based on the January 2004 inventory conducted of the existing hospital/infectious/ medical waste incinerators, only 111 units are in operation in all the EPA regions. A list of those facilities currently operating incinerators can be found at: *http://www.epa.gov/ttn/atw/129/hmiwi/2004hmiwi_inventory.xls*.

Boilers

Many hospitals operate industrial boilers, which can generate criteria pollutants (e.g., NO_x, SO_2, particulates, CO) and hazardous air pollutants (HAPs). NO_x emissions from combustion in boilers and waste incinerators is the most serious criteria air pollutant generated by the healthcare industry. Currently, information is not available on the number of boilers, and their associated emissions, in the healthcare industry. EPA recently finalized a rule for industrial/commercial/institutional boilers. EPA's air toxics web site *http://www.epa.gov/ttn/atw/boiler/boilerpg.html* provides information regarding EPA's HAP regulations for industrial/commercial/institutional boilers and process heaters. Because the rule only applies to major sources (i.e., those that emit at least 10 tons per year of a specific HAP or a combined total of 25 tons per year of all HAPs), most medical facilities will be exempt from the regulations. However, medical facilities that are colocated with other HAP-emitting facilities, such as on military bases or college/university campuses, could be subject to the new standards if the "site" as a whole meets the definition of major.

Most hospital boilers are subject to the federal New Source Performance Standards (NSPS) regulations. The applicable regulations can be found at 40 CFR Part 60 Subparts Db and Dc. Depending on the type of fuel combusted, the regulations have emission standards for sulfur dioxide, nitrogen oxides and particulate matter. Additionally, expansion of the facility may lead to Clean Air Act Prevention of Significant Deterioration (PSD)/New Source Review (NSR) requirements. See Section VI of this Notebook for more information.

V. POLLUTION PREVENTION OPPORTUNITIES

Pollution prevention is a way to reduce the impact that a business makes on the environment. This includes reducing waste, emissions, accidental releases, fires, global waste and emissions, and depletion of raw materials and using nonrenewable energy. The healthcare industry has numerous opportunities to prevent pollution. By implementing well-planned pollution prevention strategies, facilities can improve efficiencies, save money, minimize adverse environmental impacts, and offer a healthier workplace. Opportunities vary from facility to facility and relate to the volumes and types of activities.

This section is intended to provide the reader with an understanding of some of the most common pollution prevention opportunities available to the healthcare industry. Many programs are not specifically covered by this document. For more information on the various pollution prevention opportunities available to the healthcare industry, visit the industry web sites discussed in Section VIII of this document.

V.A. General Pollution Prevention Opportunities

V.A.1. Environmental Management Systems (EMS)

Environmental Management Systems work to apply the building blocks of effective organizational management (accountability, assigned responsibilities, employee involvement, written policies, training, periodic review and corrective action, senior management support and involvement) to environmental performance. They do this by challenging a hospital to identify all of its significant environmental impacts, determine which are most important, and set performance-based objectives and targets to minimize these impacts on an ongoing basis. A comprehensive EMS will include all feasible aspects of pollution prevention.

EPA has developed a resource titled "Healthcare Guide to Pollution Prevention Implementation through Environmental Management Systems," which is a comprehensive resource for understanding the components of an EMS and for developing an EMS specific to a healthcare facility. The first edition of this document can be found at: *http://www.epa.gov/region02/healthcare/*.

V.A.2. Purchasing/Product Substitution/Source Reduction

Selection of less toxic or less polluting products can reduce pollution generation. Source reduction opportunities exist in many functional areas within healthcare. Purchasing products with minimum waste or minimum toxicity (i.e., environmentally preferable purchasing (EPP) strategy) can reduce the waste generated at the facility. Web sites with resource information for source reduction include Hospitals for a Healthy Environment (H2E) at *www.h2e-online.org* and the Sustainable Hospitals project at *www.sustainablehospitals.org.*

Examples of these approaches in healthcare include:

- **Non-mercury-containing products and devices** - Purchasing and using non-mercury-containing fixatives in the laboratory and technologies for vital sign monitoring (thermometers and sphygmomanometers) help to reduce mercury pollution.

- **Purchasing a less hazardous product for use in adhering electrodes to the scalp for EEGs** - Using less hazardous products instead of flexible collodion, which is made from alcohol and ether, is a direct strategy for source reduction.

- **Mattress selection (reduces solid waste generation)** - Using mattresses with built-in egg crates reduces the need for foam mattress overlays. Healthcare bedding items are changed out every 5 to 7 years, or more frequently depending on usage. Patient comfort, ease of cleaning, and bed sore prevention are goals to be considered in bedding purchases. Selecting mattresses with built-in, rather than disposable, egg-crate foam layers, allows for the desired attributes to be available in a semidurable, versus readily disposable, product.

- **Respiratory care products (reduces solid waste generation)** - Using reusable respiratory therapy products can help reduce waste volumes. Specific products such as ambu bags (used in respiratory resuscitation) and ventilator circuit tubing (used as a channel for air in ventilators) are available as reusable products. The energy, chemicals, labor, and space needs for having a reusable/reprocessing function on site should be evaluated. In cases where the cost benefit is favorable, this strategy makes sense.

- **Microfiber mopping** - This type of product substitution can have multiple benefits including reduced water and cleaner/disinfectant use and disposal (reduces cost, chemical hazards, storage space), less weight to lift (ergonomic benefit, lower potential for injury), reduced mopping time (more productive use of staff, lower labor cost), reduced opportunity for slips and falls on a wet floor, no cross-contamination, and preferred by patients because it is quieter and less intrusive.

V.A.3. Process Change

Process changes are intentional modifications in activities that reduce pollution. Examples of this are abundant in healthcare. Some of the process changes that have environmental benefits also have other benefits, such as cost containment or improved quality of a service or product.

Examples of process changes in healthcare include:

- **Switch to digital imaging for radiology processing (reduces silver waste outputs)**. Digital imaging and PAX-it brand systems use digital images instead of silver-laden X-ray films; this negates the need for fixer/ developer solutions, which also contain silver, and reduces water consumption.

- **Right-sizing formaldehyde collection containers (reduces formalin waste outputs)**. This practice involves having a variety of sizes of collection containers filled with the preserving fluid (usually formalin), and matching the tissue sample to the appropriate container size. Previously, many facilities stocked only a few sizes of container, with the smallest being a 4-ounce container. Carrying seven or eight different size containers allows the practitioner to select the most appropriate size container based on specimen size. In one case study, this approach reduced formalin use by as much as 70 percent, and minimized waste formalin by a similar amount. The facility saved money by using less formalin, purchasing smaller containers, and saving on space, as greater quantities of the smaller containers could be stored on site.

- **Pharmaceutical Return Programs (reduces pharmaceutical product outputs).** Implementing a pharmaceutical returns program can be a valuable practice in reducing pollution associated with pharmaceuticals. The change involves switching from disposal via drains, solid waste receptacles, and biohazard waste receptacles to a system where unused and partially used pharmaceutical products are returned to a reverse distribution company for cataloging, return credit, characterization, and disposal. Note, reverse distribution should only be used for items that are not expired and not for pharmaceuticals that are obviously waste with no potential for reuse. More information on the return program can be found at *http://www.returnsindustry.com*.

- **Improve pharmaceutical dispensing practices and minimize product packaging.** Minimizing the amount of wasted pharmaceuticals produced through inefficient dispensing practices can help reduce the amount of pharmaceuticals that the healthcare facility needs to purchase. Additionally, minimizing the amount of packaging will help reduce the amount of municipal waste produced.

- **Improved segregation and management of chemotherapy medications**. Setting up concise waste segregation programs for managing chemotherapy wastes can reduce pollution and improve worker safety. Some chemotheraputic drugs are RCRA listed. Other chemotherapy medications may be RCRA characteristic. Best management of such wastes involves setting up management programs to

separate bulk chemotherapy wastes (where there is an identifiable residual amount present) from non-regulated chemotherapy wastes (e.g., gloves, personal protective equipment, and packaging from non-regulated materials), which can usually be packaged and disposed of with biohazard waste. These are fine distinctions and require careful planning and staff education. This type of program, coupled with a reverse distribution program for unused pharmaceutical products, can mitigate pharmaceutical waste outputs that can impact all media.

- **Improved waste segregation systems (reduces biohazardous waste outputs, can increase solid waste outputs and recyclable waste outputs).** Establishing waste segregation systems that allow for the separate collection of solid wastes, recyclable wastes, and biohazardous wastes increases the likelihood that wastes can be collected and handled in the most appropriate and cost-effective fashion. In the case of biohazardous waste collection, by implementing staff education, installing appropriately labeled and convenient containers, and establishing relevant collection schedules, an organization can realize substantive reductions in biohazardous waste outputs and costs. In large part, this results from staff having the option to discard packaging wastes and other waste materials that are not contaminated, as solid waste or a recyclable waste.

V.A.4. Recycling

Waste volumes can dramatically be reduced if systems are in place to capture recyclable materials such as cardboard, paper, glass and aluminum beverage containers, scrap metals, wood waste, kitchen grease, and selected plastics. Recycling success and opportunities are usually linked to recycling infrastructure at the community level.

Opportunities for Reducing Solid Waste

Setting up programs to recycle paper, cardboard, glass, plastic, wood and other types of waste can dramatically reduce a facility's solid waste output. Other factors to consider include:

- Paper wastes - measures must be implemented to ensure the confidentiality of patient information.

- Beverage container collection/recycling (aluminum and plastic) - suitable storage and timely collection schedules are needed to prevent rodent and insect problems and foul odors, and to minimize the environmental benefit if the facility has to use pesticides.

- Durable goods such as furniture, equipment, pallets - these items can be recycled and reduce waste volumes. Mattresses are a bulky and

problematic waste for many facilities; they can hire companies that recycle bedding materials to collect and recycle bedding.

- Environmentally Preferable Purchasing (EPP) - Purposely purchasing recycled materials or materials made of recycled products in place of non-recycled materials reduces solid waste generation. Examples of products containing recycled materials are available on *www.epa.gov/cpg*.

- Universal Wastes - Collecting universal wastes separately helps streamline recycling efforts for facilities as these wastes are regulated by streamlined management rules. Universal wastes found in healthcare facilities include nickel cadmium or sealed lead-acid batteries, mercury-containing thermostats, and lamps that have a hazardous component.

Opportunities for Reducing Hazardous Waste Through Recycling Initiatives

As technologies continue to advance, more opportunities for recycling hazardous waste become available. For example,

- Reducing waste solvents, alcohols, formalin, and formaldehyde - hospital laboratories can use technologies that recycle solvents, formalin, and alcohols, making them essentially continually reusable products, that can be used over and over. There is a very small residual, referred to as 'still bottoms' that is generated during the recycling process and requires disposal as a hazardous waste. Healthcare facilities should check with their state regulations before installing recycling units.

- Reducing fluorescent bulb wastes - Collecting fluorescent bulbs for recycling as a universal waste reduces the measurable volume of hazardous waste.

V.B. Pollution Prevention Opportunities by Waste Type

Table V-1 highlights some examples of pollution prevention and waste management strategies by each waste type. Facilities can use this table with Table III-2 in Section III of this Notebook to help recognize the areas where these waste categories are generated. These strategies are meant to be illustrative examples and not a comprehensive list. For more information on recycling opportunities in the healthcare industry, visit the web sites discussed in Section VIII of this document.

Table V-1: Pollution Prevention and Waste Management Strategies by Waste Category

Waste Category	Specific Wastes/Emissions Found in this Category	Waste Management Strategy
Municipal Solid Waste	Cardboard, paper, boxboard, magazines, newspaper, metals (steel and aluminum), glass, plastics, food waste, leaf and yard waste, mixed materials, mattresses, furniture, pallets, carpet, packaging materials	Work with suppliers to reduce the amount of packaging waste that must be disposed of. Recycle materials as local infrastructure permits. Donate durable/bulky goods for reuse in other settings (consider zoos, veterinary clinics, local shelters, etc.). Collect packaging materials for reuse (foam peanuts, foam inserts, airbag inserts). Recycle mattresses and carpeting with specialty recyclers. Consider composting programs (on site or off site) for organic wastes such as food waste, leaf and yard wastes. Provide food scraps that can't be used as livestock feed to local farms. Educate employees about the importance of source reductions, reuse, and recycling. Reduce packaging, use double-sided printing capabilities, reuse items when feasible, use e-mail and electronic communications among staff, and use electronic forms. Change to reusable drapes, gowns, and linens where appropriate. Purchase mattresses with built-in comfort pads to eliminate the use of disposable ones. File insurance claims and purchase orders electronically instead of mailing paper forms.

Table V-1: Pollution Prevention and Waste Management Strategies by Waste Category (Continued)

Waste Category	Specific Wastes/Emissions Found in this Category	Waste Management Strategy
Municipal Solid Waste (Continued)		Place standard forms on the computer to view and send electronically. Reduce cafeteria waste by offering discounts for those who use their own coffee mugs, soda cups, and food trays. Use old linens as rags. Develop reusable containers for vendor shipments. Switch to reusable plates for patient care. Switch from cloth sterilization wrappers to reusable sterilization canisters. Reduce duplicate items in admissions kits. Purchase recycled-content products and supplies for the cafeteria and office areas as well as for maintenance and janitorial operations. Look for information and consider implementing a municipal waste reduction strategy under the EPA WasteWi$e program, which provides technical assistance, goal setting, and recognition for accomplishments: *www.epa.gov/wastewise*.
	Construction and demolition wastes (C&D)	Much construction and demolition waste consists of wood waste, mortar products, metals, and mixed materials. Separate these wastes by material type and recycle or reuse them in other settings. Conduct drain trap cleanouts prior to construction and renovation projects, especially in areas where activities that used mercury-containing products were conducted (e.g.: former patient care areas, former laboratory settings, former reprocessing and supply decontamination areas, former dental suites/ clinics). Handle C&D wastes that contain lead, asbestos or mercury as hazardous waste or in adherence to regulatory guidelines.

Table V-1: Pollution Prevention and Waste Management Strategies by Waste Category (Continued)

Waste Category	Specific Wastes/Emissions Found in this Category	Waste Management Strategy
Biohazardous Waste, Regulated Medical Waste (RMW)	Sharps waste, blood and blood products, pathological waste, selected isolation wastes, cultures and stocks from laboratories, blood-soaked bandages, etc.	Sharps - collect sharps waste in leakproof, puncture-resistant, cadmium-free containers. In some regions, reusable sharps collection container programs are available. This can reduce overall volumes associated with collection container wastes. Educate staff to ensure that sharps containers are solely for sharps, and items such as batteries or broken mercury thermometers should NEVER be discarded in such containers. RMW - use cadmium-free red bags to collect waste. Where feasible, explore using reusable packing/shipping containers to eliminate cardboard shipping boxes. Ensure that staff have proper education about what items can be discarded into biohazardous waste containers/red bags. Note: in Oncology and Pharmacy, ensure that only non-regulated chemotherapy is disposed of in biohazard waste containers. Non-regulated chemotherapy waste is allowed to be discarded in biohazardous waste in some states while other states require that it is collected in yellow bags. Set up systems that collect 'soft' non-regulated chemotherapy wastes in the required bags and 'sharp' non-regulated chemotherapy wastes in rigid leakproof containers. This measure will reduce the volume of packaging wastes. Label this waste 'for incineration only" (or for other technologies as they become available) and label the waste at point of generation. Pathological waste - label pathological wastes for appropriate treatment such as incineration only, or other treatment technologies that become available such as plasma arc or alkaline treatment. Ensure that formalin or formaldehyde has been decanted from specimens prior to packaging for disposal. Pollution prevention strategies for this category of wastes can also be associated with selection of disposal route/technology.

Table V-1: Pollution Prevention and Waste Management Strategies by Waste Category (Continued)

Waste Category	Specific Wastes/Emissions Found in this Category	Waste Management Strategy
Biohazardous Waste, Regulated Medical Waste (RMW) (cont.)		These can include: 1) Minimizing use of incineration. 2) Consider on-site treatment technologies such as autoclaving or chemical/mechanical systems for the majority of RMW to reduce pollution associated with transporting wastes great distances over roadways. 3) Use drain disposal for liquid wastes (such as common body fluids) that are routinely generated and flushed down the toilet in household settings.
Hazardous Waste	Solvents Selected pharmaceuticals Ethylene oxide (EtO) Mercury-containing equipment or compounds Lead-containing equipment	Collect and recycle solvents. Identify RCRA listed and characteristic pharmaceuticals. Implement inventory control and management options. As a product management strategy, utilize a reverse distribution company for unused/unexpired product returns. Monitor auto dispensing machines for expired pharmaceuticals. Dispose of residual amounts of liquid properly. Minimize use of EtO where possible. Discontinue use of mercury-containing instruments and chemicals. Notify suppliers/vendors of NO MERCURY policy. Send mercury-containing products for reclamation (retorting). Identify lead-containing supplies and equipment, particularly in radiology areas, and designate for reuse, recycling or hazardous waste disposal. Note: Much lead-shielding material, when no longer suitable for use in intended purpose, can be adapted for other uses within the radiology department.

Table V-1: Pollution Prevention and Waste Management Strategies by Waste Category (Continued)

Waste Category	Specific Wastes/Emissions Found in this Category	Waste Management Strategy
Hazardous Waste (cont.)	Hazardous chemicals	Implement chemical purchasing, inventory and management systems in laboratory settings, plant operations, boiler areas, paint, electric and plumbing shops, and other areas. Label and store waste in accordance with RCRA regulations. Use secondary containment measures for storage of hazardous chemicals and storage of hazardous chemical wastes. Develop appropriate facilities to store hazardous chemical wastes. Have spill preparedness systems in place, secondary containment, neutralizing agents, and other resources to minimize problems associated with managing hazardous materials and wastes. Seek less harmful alternatives through environmentally preferable products from such places as the Sustainable Hospital Project (*www.sustainablehospitals.org*).
Radioactive Wastes	Radioactive materials and residues in drains and piping	Work with radiation safety officer to establish protocols for radioactive waste decay, strategies to minimize the amounts of radioactive wastes generated, etc.
Pressurized Containers	Gas cylinders, gas cartridges, aerosol cans, oxygen farms	Eliminate any gas cylinders on site that are not currently in use or that do not have a specific purpose. Return to vendor for recycling where possible.

Table V-1: Pollution Prevention and Waste Management Strategies by Waste Category (Continued)

Waste Category	Specific Wastes/Emissions Found in this Category	Waste Management Strategy
Universal Wastes	Mercury-containing thermostats, and spent fluorescent lamps and other hazardous lamps. Hazardous waste batteries, hazardous waste pesticides - recalled or sent to collection program. States may have additional universal wastes such as electronics.	Collect and recycle mercury-containing bulbs and thermostats. Develop a separate storage area for universal wastes; use proper labeling and storage methods. Contact the vendor or service representative to determine if mercury-free alternatives exist. Discontinue use, where feasible, of mercury-containing switches, thermostats, etc. Clearly label the device as one containing mercury and requiring special care and handling. Maintain a list of where mercury-containing devices are located in the facility. Train and advise maintenance staff to routinely monitor for leakage and to respond appropriately if a leak occurs. Develop a maintenance protocol for when the article needs to be recalibrated, handled, or replaced. Have mercury spill cleanup materials available in areas where mercury cannot be phased out in the near term (e.g., boiler switches in boiler room areas). When the device needs replacement due to age or efficiency, replace it with a nonmercury alternative.
Construction and Demolition Debris containing asbestos or other hazardous material	Asbestos Mercury Lead PCBs from old fluorescent lights and transformers	Conduct thorough walk-throughs prior to renovations to identify possible sources of asbestos, mercury, or lead materials. Conduct drain trap cleanouts prior to renovations in areas that once used mercury-containing products or materials. Work with a certified vendor to manage lead or PCB waste materials as they are encountered during renovations.

Table V-1: Pollution Prevention and Waste Management Strategies by Waste Category (Continued)

Waste Category	Specific Wastes/Emissions Found in this Category	Waste Management Strategy
Wastewater	Potentially, any hazardous substance in any clinical area Oils Hydraulic fluid Chemical spills Recycle and heat recovery from boilers, cooling towers, and laundry facilities wastewater	Identify all direct discharge drains within the facility. Examine materials used and stored in proximity to the drains. If materials are potentially problematic (e.g., oils, hydraulic fluids, formaldehyde, or other hazardous chemicals), ensure that drain mat covers, spill cleanup materials, and training for spills are part of the operations plan for the area. Examine decontamination areas in emergency departments (areas where victims of chemical or biological exposures are cleansed prior to receiving medical treatment) to ensure that systems are in place to capture contaminated fluids resulting from decontamination activities.
Stormwater	Runoff from building, lawns, parking areas, underground storage tank areas, aboveground storage tank areas, disturbed soils during construction	Identify storm drains outside the facility, and explore what substances might be inadvertently discharged into them. For example, if the on-site solid waste compactor is uphill from the nearest storm drain, ensure that spill cleanup materials are nearby in the event of a hydraulic fluid leak in the compactor. If the loading dock (shipping and receiving) is near a storm drain, ensure that spill cleanup materials are nearby in the event of a chemical spill (e.g., from a large barrel of floor stripper or other potentially toxic substance). Minimize use of fertilizers and pesticides. Clean oil spills from vehicles. Cover storage tanks areas. Have spill cleanup materials readily available in relevant locations. Ensure staff have adequate training to respond to spills to minimize resulting damage. For construction project, use stormwater best practices to keep sediment and other contaminants out of run-off.

Table V-1: Pollution Prevention and Waste Management Strategies by Waste Category (Continued)

Waste Category	Specific Wastes/Emissions Found in this Category	Waste Management Strategy
Air Emissions	Air conditioning and refrigeration units	CFC/Freon management systems.
	Boilers	Use steam generated from incinerators to partially replace boilers. Purchase ENERGY STAR qualified boilers, which use about 10% less energy than a standard boiler.
	Medical waste incinerators	Minimize biohazardous waste quantities to reduce frequency of needing to run incinerator. Establish definitive waste segregation programs to minimize inappropriate segregation of hazardous wastes (e.g., mercury spill cleanup materials) in biohazardous waste stream. Minimize the use of PVC (polyvinyl plastic) products and packaging materials to reduce the likelihood of creating dioxin emissions (2,3,7,8 dioxin).
	Asbestos removal	Work with a certified vendor to conduct this process safely.
	Paint booths	Install a filtering ventilation system to collect paint fumes.
	EtO sterilizers	Minimize use of EtO where feasible. Use EtO scavenging units on external stacks. Use air monitoring systems within the facility to monitor for EtO leaks.
	Anesthesia services	Employ scavenger systems.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the federal regulations that may apply to the healthcare sector. The purpose of this section is to highlight and briefly describe the applicable federal requirements, and to provide citations for more detailed information. The four following subsections are included:

- Section VI.A contains a list of regulations specific to this industry;
- Section VI.B contains a list of regulations by waste category;
- Section VI.C contains a list of pending and proposed regulatory requirements; and
- Section VI.D contains a list of additional applicable non-EPA regulations.

The descriptions within Section VI are intended solely for general information. While EPA has made every effort to ensure the accuracy of this information, depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. States and local regulating bodies may impose more stringent requirements than those established by EPA and other federal agencies. It is beyond the scope of this compliance chapter to list the requirements of all federal, state and local regulatory bodies. For further information, consult the Code of Federal Regulations (CFR) and other state, tribal, or local regulatory agencies.

To search the CFR, go to the Electronic Code of Federal Regulations (e-CFR) at *http://www.gpoaccess.gov/ecfr/*. The e-CFR consists of two linked databases: the "current Code" and "amendment files." The Office of Federal Register updates the current Code database according to the effective dates of amendments published in the *Federal Register*. The *Federal Register* is the official daily publication for rules, proposed rules, and notices of federal agencies and organizations, as well as executive orders and other presidential documents. The *Federal Register* can be searched at *http://www.gpoaccess.gov/fr/index.html*.

VI.A. Industry-Specific Requirements

The healthcare industry is affected by multiple federal environmental statutes. In addition, the industry is subject to numerous laws and regulations from state, tribal, and local governments designed to protect and improve the nation's health, safety, and environment. Table VI-1 summarizes the major federal regulations affecting air, water, and waste outputs from the healthcare industry.

Table VI-1: Summary of Potentially Applicable EPA Regulations

Water Programs (CWA and SWDA)	
40 CFR Part 112	Oil Pollution Prevention
40 CFR Part 122	EPA-Administered Permit Programs: The National Pollutant Discharge Elimination System
40 CFR Part 141	National Primary Drinking Water Regulations
40 CFR Part 142	National Primary Drinking Water Regulations Implementation
40 CFR Part 143	National Secondary Drinking Water Regulations
40 CFR Part 144	Underground Injection Control ("UIC") Program
40 CFR Part 145	State UIC Program Requirements
40 CFR Part 146	UIC Program: Criteria and Standards
40 CFR Part 147	State UIC Programs
40 CFR Part 148	Hazardous Waste Injection Restrictions
40 CFR Part 403	General Pretreatment Regulations for Existing and New Sources of Pollution
40 CFR Part 430	Effluent Guidelines for Direct Dischargers
40 CFR Part 460	Effluent Guidelines for the Hospital Point Source Category
Solid and Hazardous Wastes (RCRA)	
40 CFR Part 260	Hazardous Waste Management System
40 CFR Part 261	Identification and Listing of Hazardous Waste
40 CFR Part 262	Standards Applicable to Generators of Hazardous Waste
40 CFR Part 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR Part 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR Part 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR Part 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR Part 268	Land Disposal Restrictions
40 CFR Part 273	Standards for Universal Waste Management
40 CFR Part 279	Standards for the Management of Used Oil
40 CFR Part 280	Technical Standards and Corrective Requirements for Owners and Operators of Underground Storage Tanks ("USTs")
Hazardous Substances and Chemicals, Environmental Response, Emergency Planning, and Community Right-to-Know Programs (CERCLA and EPCRA)	
40 CFR Part 302	Designation, Reportable Quantities, and Notification
40 CFR Part 355	Emergency Planning and Notification
40 CFR Part 370	Hazardous Chemical Reporting: Community Right-to-Know
40 CFR Part 372	Toxic Chemical Release Reporting: Community Right-to-Know

Table VI-1: Summary of Applicable EPA Regulations (Continued)

Air Programs (CAA)	
40 CFR Section 52.21	Prevention of Significant Deterioration of Air Quality
40 CFR Part 60	Standards of Performance for New Stationary Sources
40 CFR Part 61	National Emission Standards for Hazardous Air Pollutants, Subpart M, National Emission Standard for Asbestos
40 CFR Part 62 Subpart HHH	Federal Plan Requirements for Hospital/Medical/Infectious Waste Incinerators
40 CFR Part 63	National Emission Standards for Hazardous Air Pollutants for Source Categories (all applicable provisions)
40 CFR Part 68	Chemical Accident Prevention Provisions
40 CFR Part 70	State Operating Permit Programs
40 CFR Part 82	Protection of Stratospheric Ozone
All applicable provisions of State Implementation Plan Regulations (promulgated pursuant to Section 110 of the Clean Air Act) including the New Source Review regulations	
Toxic Substances (TSCA)	
40 CFR Part 745	Lead-Based Paint Poisoning Prevention in Certain Residential Structures
40 CFR Part 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
40 CFR Part 763	Asbestos
Pesticide Programs (FIFRA)	
40 CFR Part 160	Good Laboratory Practice Standards
40 CFR Part 162	State Registration of Pesticide Products
40 CFR Part 170	Worker Protection Standard
40 CFR Part 171	Certification of Pesticide Applicators
40 CFR Part 172	Experimental Use Permits

Note that, in the healthcare industry, compliance with environmental regulations may be handled in many different ways. Though ideally all employees should help comply, official responsibility could lie at the corporate level, it could lie within the healthcare facility as either a centrally or non-centrally organized activity, or it could be part of a function for vendored-out services. EPA observes that the organizations that successfully achieve compliance engage all or many employees in the various facility operations.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA are classified as either “toxic” pollutants (priority pollutants); “conventional” pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease,

and pH; or "nonconventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct (those that discharge directly to waters of the United States) and indirect dischargers (those who discharge to POTWs). The National Pollutant Discharge Elimination System (NPDES) permitting program (CWA Section 402) controls direct discharges into navigable waters. NPDES permits, issued by either EPA or an authorized state (EPA has authorized 45 states, one territory, and no tribes to administer the NPDES program), contain industry-specific, technology-based and water-quality-based limits and establish pollutant monitoring and reporting requirements. A facility that proposes to discharge into the nation's waters must obtain a permit prior to initiating a discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which the facility may discharge.

EPA has established technology-based discharge standards for hospitals that are direct dischargers. These standards limit 5-day biochemical oxygen demand (BOD_5) and total suspended solids as a mass value calibrated per 1,000 occupied beds. pH is also limited. In contrast, water-quality-based discharge limits are based on federal or EPA-approved state or tribal water quality criteria or standards that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technology-based standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from state to state and site to site, depending on the use classification of the receiving body of water. Most states and territories follow EPA effluent guidelines, which propose aquatic life and human health criteria for many of the 126 priority pollutants. The permitting agency (EPA or the authorized state) is obligated to impose the more stringent of these two types of limits in the permit issued to the applicable hospital.

As stated in Section III.B.4 of this document, healthcare facilities wastewater sources include sinks, drains, showers, toilets, and tubs; photographic development drains from radiology (X-rays), other imaging, and dentists; and stormwater. The healthcare industry is subject to various provisions of the CWA including:

- Wastewater Discharges - NPDES Effluent Limitations and Guidelines for Direct Dischargers (guidelines for direct discharging hospitals with more than 1,000 occupied beds) and General Pretreatment Standards.

- Stormwater Permits: Municipal separate storm sewer systems (MS4), such as those from hospitals, and construction activities are subject to stormwater permitting requirements.

- Oil Pollution Prevention Requirements: Hospitals that have a total aboveground oil storage capacity exceeding 1,320 gallons or an underground storage capacity exceeding 42,000 gallons are subject to spill prevention control and countermeasure (SPCC) plan requirements.

Wastewater Discharges

As stated above, the water regulations establish different permitting programs for direct and indirect wastewater discharges. EPA's NPDES web site *http://cfpub.epa.gov/npdes* provides technical and regulatory information about the NPDES permit program that controls water pollution by regulating point sources (e.g., pipe, ditch) that discharge pollutants into waters of the United States. Most hospitals are indirect dischargers.

- Indirect Dischargers: Hospitals that are indirect dischargers are subject to regulations by the local sewer authority. At present, approximately 1,500 of the nation's largest municipalities are required to implement industrial pretreatment programs that include issuing industrial user permits to significant industrial users. Some municipalities have determined hospitals to be significant industrial users.

  Most municipalities have established local prohibitions that apply specifically to medical waste discharges. For example, some municipalities have set a prohibition on "all medical waste." Other prohibitions include, for example, no discharge of discernible body parts, no human remains greater than 0.5 inches in diameter, and/or no radioactive wastes. The ability of municipalities to establish prohibitions to meet their specific needs/interests is very flexible.

  Federal Pretreatment Regulations prohibit discharges of fire or explosion hazards; corrosive discharges (pH < 5.0); solid or viscous pollutants; heat (in amounts that cause the treatment plant influent to exceed 104 degrees F); pollutants that cause toxic gases, fumes, or vapors; and any other pollutant (including oil and grease) that will interfere with or pass through the treatment plant.

- Direct Dischargers: There are very few direct discharging hospitals as reported to PCS in 2004 (e.g., 11 with non-major NPDES permits and 1 with major NPDES permit using SIC Code 806). Hospitals that are direct dischargers of process and sewer wastes must be permitted (i.e., obtain a permit) for any point source discharge of pollutants to waters of the United States. These permits are issued either by EPA or the state, where the state has been authorized to implement the NPDES Permit Program. The federal regulations establish the permit application and permit requirements. Specific numeric limitations that apply to a medical facility depend on the more stringent limits determined by the applicable technology-based discharge standards (40 CFR 460) and water quality standards for the receiving stream of the discharge. For detailed information on numeric limitations, contact your EPA Regional pretreatment coordinator. Contact information can be found at the following web site.
  http://cfpub.epa.gov/npdes/contacts.cfm?program_id=0&type=NPDES

Stormwater Discharges

The stormwater program is part of the NPDES program and is designed to prevent the discharge of contaminated stormwater into navigable waters. See the web site at: *http://cfpub.epa.gov/npdes/home.cfm?program_id=6*

Phase I of the stormwater program was promulgated in 1990 and applied to medium and large municipal separate storm sewer systems (MS4), certain industrial facilities (not hospitals), and any construction activity disturbing greater than 5 acres (large construction sites).

Phase II of the stormwater program was promulgated in 1999 and applies to small municipal separate storm sewer systems (MS4) and construction activity greater than 1 acre and less than 5 acres (small construction sites). Hospitals located in urbanized areas are regulated under this new rule. Any hospital located in urbanized or rural areas that are planning construction activities should look into obtaining a stormwater NPDES permit for construction.

The term MS4 does not solely refer to municipally owned storm sewer systems, but rather is a term with a much broader application that can include, in addition to local jurisdictions, state departments of transportation, universities, local sewer districts, hospitals, military bases, and prisons. A MS4 also is not always just a system of underground pipes - it can include roads with drainage systems, gutters, and ditches. Hospitals in urbanized areas should consult with their state NPDES authority to evaluate whether a permit authorization is required.

The regulatory definition of an MS4 is provided in 40 CFR 122.26(b)(8). General stormwater information can be found at *http://cfpub.epa.gov/npdes/home.cfm?program_id=6* and the Stormwater Phase II Compliance Assistance Guide, at *http://www.epa.gov/npdes/pubs/comguide.pdf.*

Aboveground or Underground Oil Storage Containers

EPA's oil spill program web site, *http://www.epa.gov/oilspill/*, provides information about EPA's program for preventing, preparing for, and responding to oil spills that occur in and around inland waters of the United States. If a hospital uses or stores oil it may be subject to the Spill Prevention Control Countermeasure (SPCC) rule. Hospitals with an above ground oil storage capacity of greater than 1,320 gallons, or total completely buried oil storage capacity greater than 42,000 gallons must prepare and implement a SPCC plan to prevent any discharge of oil into or upon navigable waters of the United States or adjoining shorelines.

On July 16, 2002, EPA promulgated a revised final SPCC Regulation which became effective August 17, 2002. EPA subsequently extended the regulatory compliance schedule included in the new SPCC rule.

The current compliance dates for the new rule are:

- February 17, 2006: Facilities must prepare and a Professional Engineer (P.E.) certify an SPCC Plan in accordance with the new SPCC rule by this date.

- August 18, 2006: The revised SPCC Plan must be implemented.

In the interim, facilities are required to maintain their existing SPCC Plan and amend it in accordance with 40 CFR §112.5.

CWA Common Areas for Inspections

While an EPA inspector is authorized to examine a wide range of documents and operations, he/she will probably be interested in three areas of a hospital: wastewater discharges, stormwater discharges, and any aboveground or underground oil storage containers.

Typical Records an EPA Inspector May Ask to Review under the CWA

- Industrial User permit (IU permit) for discharges to the local municipality (indirect discharge). Most hospitals are indirect dischargers.

- Spill Prevention, Control, and Countermeasure (SPCC) Plan. The plan is to prevent any discharge of oil into or upon navigable waters of the United States or adjoining shorelines.

- Phase II stormwater permits under the NPDES program for public hospitals located in an urbanized area.

- NPDES construction stormwater permits (Phase I and Phase II) are also required for any construction activity greater than 1 acre for any hospital located in urban or rural areas.

- NPDES general permit for discharging directly to a water body (direct discharge).

EPA's Office of Water operates a Water Resource Center with a 24-hour voice mail system for publication orders or reference questions at (202) 566-1729 (e-mail address: center.water-resource@epa.gov). Long-distance callers in the United States may also use the Wetlands Helpline ((800) 832-7828), operating weekdays from 8:30 a.m. to 4:30 p.m., EST, excluding federal holidays. Visit the Office of Water web site (http://www.epa.gov/water/) and the NPDES web site (http://cfpub.epa.gov/npdes/) for additional material.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint federal-state (or federal-tribal) system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water by controlling underground injection of fluid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized states and territories enforce the primary drinking water standards, which are contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are nonenforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set generally as close to MCLGs as possible, considering cost and feasibility of attainment.

A hospital would be considered a nontransient, noncommunity water system (i.e., a public water system) if it regularly serves at least 25 of the same persons 6 months per year from its own water source. The hospital would thus be required to comply with SDWA monitoring and reporting requirements. Healthcare facilities that have their own drinking water treatment to comply with MCLs should be aware that they could generate hazardous or radioactive waste (e.g., some areas have elevated arsenic levels in groundwater.)

Part C of the SDWA mandates EPA to protect underground sources of drinking water from inadequate injection practices. EPA has published regulations codified in 40 CFR Parts 144 to 148 to comply with this mandate. The Underground Injection Control (UIC) regulations break down injection wells into five different types, depending on the fluid injected and the formation that receives it. The regulations also include construction, monitoring, testing, and operating requirements for injection well operators. All injection wells have to be authorized by permit or by rule depending on their potential to threaten Underground Sources of Drinking Water (USDW). RCRA also regulates hazardous waste injection wells and a UIC permit is considered to meet the requirements of a RCRA permit. EPA has authorized delegation of the UIC for all well classes in 34 states, implements the program directly in 10 states and all Indian country areas, and shares responsibility with 6 states. For a hospital, an injection well can constitute any bored, drilled or driven shaft or a dug hole, where the depth is greater than the largest surface dimension that is used to discharge fluids underground as well as any on-site drainage systems, such as septic systems, cesspools, and stormwater wells, that discharge fluids only a few feet underground. Hospitals and doctors' offices must make sure that what they pour down a drain goes to a sewer, and not to a drywell or septic system.

The SDWA also provides for a federally implemented Sole Source Aquifer program, which prohibits federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a state-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791 (or (703) 412-3330 for local and international calls), answers questions and distributes guidance pertaining to SDWA standards (e-mail: hotline-sdwa@epa.gov). The Hotline operates from 9:00 a.m. through 5:00 p.m., EST, excluding federal holidays. Visit the web site at www.epa.gov/ogwdw for additional material.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) aims to manage the disposal of waste from municipalities and industries. It regulates facilities that generate, transport, treat, store, or dispose of hazardous waste. Under RCRA, most healthcare facilities are hazardous waste generators. RCRA hazardous waste regulations are in the Code of Federal Regulations (CFR), Title 40, Parts 260 to 280. A series of hazardous waste evaluation flowcharts are available on EPA Region 2's web site at *http://www.epa.gov/region02/healthcare/*. The flowcharts are based on the federal requirements. Most states are authorized the hazardous waste program and may have more stringent requirements. Healthcare facilities should check with their states for additional requirements.

Although RCRA is a federal statute, most states are authorized to administer the RCRA hazardous waste program under their own authority. Currently, EPA has authorized 48 of the 50 states and two United States territories to administer various provisions of RCRA Subtitle C. States must have regulations consistent with and at least as stringent as the federal program; some states have additional reporting requirements. Healthcare facilities should contact their state or tribal authority to determine which state or tribal requirements apply to their business. RCRA does not enable EPA to authorize tribal hazardous waste programs in lieu of the federal program; therefore, EPA directly implements RCRA hazardous waste programs in Indian country, but tribes may have their own, independent hazardous waste programs.

RCRA defines hazardous waste as a subset of solid waste. Solid waste is defined as garbage, refuse, sludge, or other discarded material (including solids, semisolids, liquids, and contained gaseous materials). Once a waste is considered solid waste, determine if it is hazardous waste. EPA defined hazardous wastes as either listed or characteristic. If a waste is specifically named on one of four lists of hazardous wastes, it is a listed waste. If a waste exhibits one of four characteristics, it is a characteristic waste. Section III.B.3 describes the listed and characteristic hazardous wastes commonly found in the healthcare field.

Under RCRA, a facility must determine its generator status. Reporting and other regulatory requirements are different for each generator type. Hazardous waste generators are divided into three categories, according to how much hazardous waste they generate in a calendar month:

- **Large Quantity Generators** (LQGs) generate greater than or equal to 1,000 kg (approximately 2,200 lbs) of hazardous waste per month, or greater than 1 kg (approximately 2.2 lbs) of acutely hazardous waste per month. EPA considers acute hazardous wastes the P-listed wastes. If facilities generate more than 1 kg (approximately 1 quart) of acutely

hazardous waste, then they are LQGs and must comply with all LQG reporting requirements. See Table III-1 for a list of some common acute and toxic healthcare hazardous wastes.

- **Small Quantity Generators** (SQGs) generate greater than 100 kg (approximately 220 lbs) but less than 1,000 kg of hazardous waste per month and/or less than 1 kg (approximately 2.2 lbs) of acutely hazardous waste per month.

- **Conditionally Exempt Small Quantity Generators** (CESQGs) generate less than or equal to 100 kg of hazardous waste per month, and less than or equal to 1 kg of acutely hazardous waste per month. Not all states recognize the CESQG classification.

- **Large Quantity Handler of Universal Waste** (LQHUW) store greater than 5,000 kg of universal waste on site.

- **Small Quantity Handler of Universal Waste** (SQHUW) store less than 5,000 kg or about 11,000 lbs of universal waste (all types combined) on any given day during the calendar year.

Entities that generate hazardous waste are subject to Federal standards applicable to generators of hazardous waste (e.g., hazardous waste manifest, pre-transportation, recordkeeping and reporting, etc). Storage of hazardous waste generally requires a permit under RCRA hazardous waste regulations, but provisions under RCRA do allow generators to "accumulate" hazardous waste on site without a permit or interim status as long as they comply, among other things, with the technical standards for the containment unit(s). The length of time a generator is allowed to accumulate hazardous waste on site without a permit or interim status depends on the generator's classification. For instance, Large Quantity Generators may accumulate any quantity on-site for 90 days or less without a permit or interim status. Small Quantity Generators may accumulate no more than 6,000 kg of hazardous waste without a permit or interim status for 180 days or less (or for 270 days or less depending on transport distance). CESQGs may accumulate 1,000 kg of waste, 1kg acute waste, or 100 kg residue or contaminated soil from a cleanup of an acute hazardous waste spill. Generators also may treat hazardous waste in accumulation tanks or containers (in accordance with the requirements of 40 CFR Part 262.34) without a permit or interim status. Facilities that treat, store, or dispose of hazardous waste generally are required to obtain a RCRA permit.

Generator status is determined by calendar month; therefore, one month a facility may be a CESQG, and the rest of the year it may be an SQG. In this case, it might be easier to comply with SQG reporting requirements for consistency. On the other hand, if the facility is usually an SQG, a store room or laboratory cleanout might push it into being an LQG. In exceptional cases like this when it is a one time occurrence, some states have made exceptions so that the cleanout does not trigger LQG status.

Generators "count" the amount of waste generated, by adding up the total weight of all quantities of characteristic and listed waste generated at a particular facility. Certain wastes, such as those that are reclaimed or recycled continuously on site, are not counted under the federal regulations but might be counted under some state regulations. Facilities should also determine if their state has adopted the universal waste rule, which would cover mercury-containing thermostats, certain batteries, and fluorescent light bulbs. Universal wastes do not count toward determining generator status.

Most RCRA requirements are not industry-specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Below are some important RCRA regulatory requirements that apply to healthcare facilities:

Identification of Solid and Hazardous Wastes (40 CFR Part 261) establishes the standard to determine whether the material in question is considered a solid waste and, if so, whether it is a hazardous waste or is exempted from regulation.

Standards for Generators of Hazardous Waste (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA identification number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste on site for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit. If the waste must be transported more than 200 miles away for recovery, treatment, or disposal, the generator may accumulate the waste for up to 270 days.

Standards for Transporters of Hazardous Waste (40 CFR Part 263) apply to persons transporting manifested shipments of hazardous waste within the United States. Transport requires an EPA identification number, a hazardous waste manifest, compliance with Department of Transportation (DOT) requirements, and proper recordkeeping.

Land Disposal Restrictions (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

Used Oil Management Standards (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of used oil. For parties that merely generate used oil, regulations establish storage standards. A party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil directly to a used oil burner), must meet additional tracking and paperwork requirements.

RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including Tanks and Containers. Tanks and containers used to store

hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities that store such waste, including large quantity generators accumulating waste prior to shipment off site.

Underground Storage Tanks (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that were to be met by December 22, 1998.

Boilers and Industrial Furnaces (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and, in some cases, restrict the type of waste that may be burned.

Imminent Hazard RCRA Section 7003 gives EPA a broad and powerful enforcement tool to use in abating imminent hazards caused by hazardous or solid wastes. Section 7003 states that upon receipt of evidence that the past or present handling, storage, treatment, transportation, or disposal of any solid waste or hazardous waste may present imminent and substantial endangerment to human health or the environment, EPA may bring suit against any person who has contributed or who is contributing to the handling of the waste to restrain the person, order the person to take any action that may be necessary, or both. This authority is used only in extreme circumstances.

Some wastes have special exclusions for practices that are not considered to be hazardous, as determined by federal policy. Several exclusions and exemptions pertain specifically to healthcare facilities. Keep in mind that some states do not recognize the federal exclusions. Some federal exclusions, exemptions, and other special circumstances that are relevant to healthcare facilities are listed below:

- **Domestic Sewage Exclusion**. Mixtures of domestic sewage and other wastes that discharge to a sewer system to a POTW for treatment are excluded from the definition of solid waste. For example, employees may generate a hazardous waste by washing hands with a soap containing a listed hazardous waste. The mixture will be going through a POTW; therefore, it is excluded from the facility's hazardous waste "count." Generators need to contact their local POTW for prior approval. Note that wastes must actually reach the POTW to be covered by this exclusion. Waste that volatilizes in the drain or corrodes the pipes does not reach the POTW.

- **Point Source Exclusions**. Point source discharges of industrial waste waters that are subject to regulation under Section 402 of the CWA are excluded from the definition of solid waste.

- **De Minimis Exclusion**. Small quantities of some solvents and other chemicals are exempt from the regulations when they are mixed with wastewater in a wastewater treatment system discharging, according to the Clean Water Act.

- **Elementary Neutralization Unit**. Tanks used for neutralizing waste that is hazardous solely because of its corrosive characteristic are excluded from the permitting requirements.

- **Nitroglycerine Formulation**. As of August 14, 2001, federal regulations of nitroglycerine formulations are exempt from hazardous waste regulation as long as they do not exhibit the characteristic of reactivity. Medicinal nitroglycerine are typically not reactive and therefore would not be regulated. This interpretation is based on the revised mixture and derived-from rules [40 CFR 261.3(g)(1)]. Healthcare facilities should check with their state environmental regulatory agency to see if this rule applies in the state in which they operate.

- **Wastewater Treatment Unit**. Any hazardous waste tank system used to store or treat the wastewater that is managed at an on-site wastewater treatment facility with an NPDES permit or that discharges to a POTW is exempt from the RCRA regulations. Most healthcare facilities do not perform this type of wastewater treatment but instead perform elementary neutralization, discussed below.

- **Mixed Wastes**. In May 2001, EPA issued a rule offering a conditional exemption from RCRA requirements for mixed waste as long as it is managed in accordance with NRC or Agreement State licenses (40 CFR Part 266, Subpart N). This exemption covers on-site storage and means that facilities no longer have to obtain RCRA storage permits for mixed waste stored beyond 90 days. The rule has been adopted by 20 states, but is authorized in only two.

- **Reverse Distribution of Pharmaceuticals**. Unused pharmaceutical products shipped to reverse distributors are not considered discarded and are therefore not classified as hazardous waste. The materials must be shipped as product and not identified as waste. Check with state regulatory authorities to understand specific restrictions or requirements in each state.

- **Epinephrine Syringes**. Epinephrine residue in syringes is not considered P042 under federal RCRA hazardous waste rules. Some states may not have adopted this policy. See also *http://www.epa.gov/epaoswer/hotline/94report/12_94.txt*. Note that this federal interpretation does not apply to epinephrine in other formulations (such as vials), and note that the syringe may still be hazardous waste by characteristic.

Typical Physical Features to Inspect under RCRA

- Universal waste storage area;
- Used oil storage areas;
- Vehicle maintenance facilities;
- Battery storage areas;
- Building maintenance and repair shops;
- Laboratories;
- Bulk storage tank farms;
- Transfer terminals;
- Secondary containment structures;
- Tank peripheral piping, manifolds, filling and dispensing areas;
- Dispenser pumps and check valves;
- Tank sumps, manway areas;
- Leak detection equipment;
- Overflow alarms or other audible and visual alarms, sight gauges;
- Fill ports, catchment basins;
- Oil/water separators;
- Cleanup equipment (e.g. absorbent materials, fuel recovery pumps, personal protective gear);
- Hazardous waste generation sites (x-ray, chemotherapy, morgue, pathology);
- Waste storage areas;
- Satellite accumulation points;
- Vehicles used for transport;
- Container storage areas; and
- Shop activities.

Typical Records an Inspector May Ask to Review under RCRA

- Notification of Hazardous Waste Activity (EPA ID No.);
- Hazardous waste manifests;
- Manifest exception reports;
- Biennial reports;
- Inspection logs;
- Land disposal restriction certifications;
- Employee training documentation;
- Hazardous substance spill control and contingency plan;
- Material Safety Data Sheets (MSDSs);
- Inventory records;
- Spill records - Spill Prevention Control and Countermeasure (SPCC) Plans;
- Emergency plan documents;
- Placarding of hazardous waste and hazardous materials;
- Permits, if issued;
- Waste analysis plan(s);

- Operating record;
- Universal waste transportation/shipping records;
- Used oil analysis records;
- Used oil transportation related documentation; and
- Underground Storage Tanks (UST) leak detection performance and maintenance including the following:

  — Monitoring results over the last 12 months,
  — Most recent tank tightness test(s),
  — Manual tank gauging records,
  — Copies of performance claims provided by leak detection equipment manufacturers,
  — Records of recent maintenance, repair and calibration of on-site leak detection equipment,
  — Records of required inspections and test of corrosion protection systems,
  — Records of repairs or upgrades of UST systems,
  — Site assessment results of closed USTs,
  — Results of AST integrity assessments, sampling, monitoring, inspection and repair work,
  — Notification forms and registration records for all in-service, temporarily out-of service, and permanently closed tanks, and
  — Waste determinations.

RCRA information is available to the public on the web at www.epa.gov/osw. The Office of Solid Waste (OSW) has also compiled a list of phone numbers and waste program web sites maintained by EPA Regional offices and state environmental agencies to help users locate site-specific information on RCRA facilities within their states. This compilation is found at www.epa.gov/epaoswer/osw/comments.htm. This site also provides links to the RCRA OnLine database (www.epa.gov/rcraonline), to a searchable database of Frequently Asked Questions (FAQs) about RCRA, and to an on-line order form for RCRA publications (www.epa.gov/epaoswer/osw/publicat.htm). More information on RCRA Subtitle C can be found at www.epa.gov/epaoswer/osw/hazwaste.htm. State specific information related to RCRA can be found at www.herc.org.

See Section VI.C of this document for information pertaining to pending regulations under RCRA.

Universal Waste Rule

EPA created the Universal Waste Rule to encourage and streamline recycling efforts. It allows facilities to count wastes as universal instead of hazardous, which does not count toward generator status. Segregating universal wastes from the rest of the hazardous waste streams can save hospitals money on disposal costs, as well as on recordkeeping. Federal universal wastes include hazardous waste batteries, mercury-containing thermostats, certain pesticides, and fluorescent light bulbs. Facilities should make sure that their state or territory has

adopted these universal wastes. Some states may have additional types of waste such as electronics on their list of universal wastes. Section III.B.3 also discusses this rule.

Medical Waste Tracking Act

In 1988, Congress enacted the Medical Waste Tracking Act under RCRA Subtitle J, which directed EPA to begin a two-year demonstration program for medical waste tracking. The demonstration program operated from June 1989 to June 1991. The program is expired and no federal tracking requirements are in place; however, many states have developed similar tracking and management programs.

Emergency Planning And Community Right-To-Know Act

This act, also known as Superfund Amendments and Reauthorization Act (SARA) Title III, was designed to promote emergency planning and preparedness at both the state and local level. It provides citizens, local governments, and local response authorities with information regarding the potential hazards in their community. EPCRA requires the use of emergency planning and designates state and local governments as recipients of information regarding certain chemicals used in the community. SARA Title III, better known as EPCRA, originated from the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or better known as the Superfund law). Like EPCRA Section 304, CERCLA also has hazardous substance release reporting regulations under CERCLA Section 103; 40 CFR Part 302. Under CERCLA, the person in charge of a facility is required to report to the National Response Center ((800) 424-8802 or www.nrc.uscg.mil) "immediately upon knowledge of a reportable release" any environmental release of a listed hazardous substance that equals or exceeds a reportable quantity.

EPCRA establishes the following types of reporting obligations for facilities that store or manage specified chemicals:

Emergency Planning (Sections 302 and 303)

Any healthcare facility that has any chemical listed on the extremely hazardous substances list at or above its planning threshold quantity must perform the following:

- Notify the State Emergency Response Commission (SERC) and Local Emergency Planning Committee (LEPC) within 60 days of receiving the shipment (or producing the substance) on site;
- Provide the LEPC with a facility representative who will participate in the emergency planning process; and
- Provide requested information for the LEPC necessary for development and implementation of the emergency plan.

Emergency Release Notification (Section 304)

If there is a reportable release into the environment of a hazardous substance, healthcare facilities must provide an emergency notification and a written follow-up notice to the LEPC and SERC (for any area likely affected). A release is reportable under EPCRA Section 304 if the amount of hazardous substance releases meets or exceeds the minimum reportable quantity set in the regulations. Two types of chemicals fall under this regulation: 1) extremely hazardous substances; and 2) CERCLA hazardous substances.

Annual Inventory (Sections 311 and 312)

Under EPCRA Section 311 requirements, healthcare facilities must submit copies of hazardous chemical material safety data sheets (MSDS) or a list of MSDS chemicals to the LEPC, SERC, and local fire department. Under Occupational Safety and Health Administration (OSHA) regulations, employers must maintain a MSDS for any hazardous chemical stored or used in the work place.

Under EPCRA Section 312, healthcare facilities that meet Section 311 requirements for a hazardous chemical must submit an annual inventory report for that chemical. The inventory report (called a Tier II report) must be submitted to the LEPC, SERC, and local fire department by March 1 of each year.

Certain chemicals are exempt from the EPCRA Section 311 and 312 definition of a hazardous chemical. One exemption that applies to the healthcare industry is the exemption of medical and research lab materials (i.e., any substance, to the extent it is used in a research laboratory or a hospital or other medical facility under the direct supervision of a technically qualified individual). A technically qualified individual meets the following definition:

- Capable of understanding the health and environmental risks associated with the chemical substance that is used under his or her supervision because of education, training, or experience, or a combination of these factors;

- Responsible for enforcing appropriate methods of conducting scientific experimentation, analysis, or chemical research to minimize such risks; and

- Responsible for the safety assessments and clearances related to the procurement, storage, use, and disposal of the chemical substance as may be appropriate or required within the scope of conducting a research and development activity.

In addition, EPCRA requirements do not apply to the transportation, including storage, of any substance, with the exception of Section 304 reporting. Therefore, materials being distributed or stored incident to transportation (i.e., under active shipping papers) would not be included in a facility threshold determination under Sections 311 and 312.

EPCRA Section 313 (Toxic Release Inventory, TRI)

The healthcare industry primarily falls under SIC codes 0741 and 0742 (veterinary services), 4119 (land ambulances), 4522 (air ambulances), 80 (hospitals and doctors' offices/clinics), 83 (social services), and 8734 (veterinary testing laboratories). These SIC codes are not required to report to TRI (i.e., submit annual reports of toxic chemical releases) under EPCRA Section 313. Federal facilities however, are subject to EPCRA Section 313. These include federal hospitals such as veterans hospitals, military hospitals, or clinics in federal prisons.

Healthcare facilities that are defined as auxiliary facilities (i.e., supports another establishments's activities) can assume the SIC code of the covered establishment that it supports. For the purposes of TRI, auxiliary facilities are defined as one primarily engaged in performing support services for another establishment(s) of a facility (in a covered SIC code) and is in a different physical location than the primary facility. If the healthcare facility meets this definition, the facility meets the SIC code criterion.

Typical Records an EPA Inspector May Ask to Review under the EPCRA

- Proof of notification for all environmental releases of a listed hazardous substance. "Failure to notify" violation will be sited if the National Response Center, State Hotline, and LEPC is not notified in a timely fashion.
- Emergency Response Plans.
- MSDS.
- Tier I or Tier II inventory reporting forms. This inspection is done together with the MSDS. The inspector will look at what materials are stored and in what quantity and if they are subject to reporting requirements. The federal government prefers the more detailed Tier II inventory form.
- EPA Toxic Release Inventory Form R for federal healthcare facilities report on every chemical manufactured, processed, or used. Form R contains facility identification information and chemical specific information (toxic chemical identity; mixture component; activity and uses; maximum amount of chemical on site during calendar year; quantity; transfers; discharges; on-site waste treatment; on-site energy recovery; on-site recycling; source reduction/recycling).

*Visit these web sites for more information: http://yosemite.epa.gov/oswer/ceppoweb.nsf/content/EPCRA.htm and http://www.epa.gov/ceppo/pubs/hotline/hazchem.html. Visit the TRI web site (http://www.epa.gov/tri/) for more details. **"List of Lists"** is a consolidated list of chemicals subject to EPCRA and CAA Section 112(r) used to help facilities*

handling chemicals determine whether they need to submit reports under Sections 302, 304, 311, 312, or 313 of EPCRA and, for a specific chemical, what reports may need to be submitted. It will also help facilities determine whether they will be subject to accident prevention regulations under CAA Section 112(r) and lists "unlisted hazardous wastes" under RCRA. It is available at http://www.epa.gov/ceppo/pubs/title3.pdf

Clean Air Act

The CAA and its amendments are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA, states, and tribes to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAA, many facilities are required to obtain operating permits that consolidate their air emission requirements. State, tribal, and local governments oversee, manage, and enforce many of the requirements of the CAA. CAA regulations appear at 40 CFR Parts 50-99.

As discussed in Section III.B.4 of this document, healthcare air emissions come from air conditioning and refrigeration, boilers, medical waste incinerators (if on site), asbestos, paint booths, ethylene oxide sterilization units, emergency generators, anesthesia, laboratory chemicals, and laboratory fume hoods.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are designated as attainment areas; those that do not meet NAAQSs are designated as nonattainment areas. Under Section 110 and other provisions of the CAA, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. Tribes may, but are not required, to develop Tribal Implementation Plans (TIP), which play the same role as SIPs, but apply within Indian country. Revised NAAQS for particulates and ozone became effective in 2004.

Title I also authorizes EPA to establish New Source Performance Standards (NSPS), which are nationally uniform emission standards for new and modified stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source (see 40 CFR Part 60).

New Source Performance Standards

NSPS at 40 CFR 60 include process-specific operational standards. Individual states may impose stricter requirements. The following NSPS are particularly relevant to the healthcare industry:

- **Boilers -** Most hospital boilers are subject to the NSPS regulations. The applicable regulations can be found at 40 CFR Part 60, Subparts Db and

Dc. Subpart Db applies to the larger boilers (greater than 100 million BTU/hr) that were constructed after June 19, 1984. Subpart Dc applies to the smaller boilers (between 10 and 100 million BTU/hr) that were built after June 8, 1989. Depending on the type of fuel combusted, the regulations have emission standards for sulfur dioxide, nitrogen oxides, and particulate matter. The NSPS also have requirements for monitoring and recordkeeping. *http://www.epa.gov/ttn/atw/boiler/boilerpg.html*.

- **Medical Waste Incinerators** - Under the CAA, EPA regulates air emissions from hospital and/or medical/infectious wastes incinerators (HMIWI). The applicable regulations can be found at 40 CFR Part 60, Subparts Ec and Ce. Subpart Ec applies to HMIWI that were constructed after June 20, 1996. Subpart Ce applies to HMIWI that were constructed before June 20, 1996. When burned, medical waste may emit air pollutants, including hydrochloric acid (Hal), dioxins and furans, and metals, such as lead (Pb), cadmium (Cd), and mercury (Hg). Therefore, EPA has developed emission standards that apply to incinerators used by hospitals and healthcare facilities as well as those used by commercial waste treatment and disposal companies to treat medical waste. The emission guidelines are intended to meet the requirements of the CAA, and states must establish standards that are at least as protective. These standards will result in reductions in the air emissions of concern from HMIWI. For additional information visit: *http://www.epa.gov/ttn/atw/129/hmiwi/rihmiwi.html*.

Hazardous Air Pollutants

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented toward controlling specific hazardous air pollutants (HAPs). Section 112(c) of the CAA further directs EPA to develop a list of source categories that emit any of 188 HAPs, and to develop regulations for these categories of sources. To date, EPA has listed 185 source categories and developed a schedule for establishing emission standards. The emission standards are being developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors. Air toxics regulations apply to several operations at healthcare facilities. The NESHAPs that apply to the industry are:

- **Asbestos** (40 CFR 61 Subpart M) - A hospital that performs demolition and renovation operations will be subject to the CAA NESHAP for asbestos. Asbestos must be removed prior to demolition or renovation and proper precautions must be made such as wetting down the material to keep in intact. No asbestos is to be stripped, removed, or otherwise handled or disturbed unless at least one authorized representative trained in NESHAP asbestos regulations is present. A written notice of intention

to demolish or renovate must be submitted to EPA at least 10 working days prior to the start of construction.

- **Industrial, Commercial and Institutional Boilers and Process Heaters** (40 CFR 63 Subpart DDDDD) - This NESHAP may apply at hospitals that are major hazardous air pollutant emitters under the CAA. A major emitter is defined as emitting 10 tons/year of a single HAP or 25 tons/year of combined HAPS. For additional information visit: *www.epa.gov/ttn/atw/boiler/boilerpg/html*.

Chemical Accident Prevention Provisions

The CAA sets forth a list of regulated substances and thresholds, a petition process for adding or deleting substances to the list of regulated substances, requirements for owners or operators of stationary sources concerning the prevention of accidental releases, and state accidental release prevention programs.

Title V Permits

Title V of the CAA requires that all "major sources" (and certain minor sources) obtain an operating permit. Healthcare facilities that qualify as a major source are required to have a Title V permit, and may be required to submit information about emissions, control devices, and the general process at the facility in the permit application. Permits may limit pollutant emissions and impose monitoring, recordkeeping, and reporting requirements.

Monitoring requirements for many facilities with Title V permits are specified in the Compliance Assurance Monitoring (CAM) regulations. For facilities that meet emissions requirements on their permits by using pollution control equipment, CAM may require that the facilities monitor the control equipment to assure that it is operated and maintained as prescribed in their permits.

Refrigerant Recycling Rule

The purpose of Section 608 of the CAA is to maximize the recovery and recycling of refrigerants during the servicing and disposal of stationary air conditioning and refrigeration equipment. Requirements include prohibition of venting, service requirements, equipment certification, leak repair, proper disposal, and recordkeeping. More information can be found at *http://www.epa.gov/region02/cfc/*.

EPA's Clean Air Technology Center, at (919) 541-0800 (in Spanish: (919) 541-1800) or http://www.epa.gov/ttn/catc, provides general assistance and information on CAA standards (e-mail: catcmail@epamail.epa.gov). The Stratospheric Ozone Information Hotline, at (800) 296-1996, or the Ozone Depletion web site (www.epa.gov/ozone), provides general information about regulations promulgated under Title VI of the CAA. RCRA information pertaining to questions about accidental release prevention under CAA Section112(r), is available in the RCRA OnLine database (www.epa.gov/rcraonline), a searchable database of

Frequently Asked Questions (FAQs) about RCRA, and through an on-line order form for RCRA publications (www.epa.gov/epaoswer/osw/publicat.htm). Information on air toxics can be accessed through the Unified Air Toxics web site at http://www.epa.gov/ttn/atw/. In addition, the Clean Air Technology Center's web site includes recent CAA rules, EPA guidance documents, and updates of EPA activities. Visit the Office of Air and Radiation (OAR) homepage for more information: (http://www.epa.gov/air/).

See Section VI.C of this document for information pertaining to pending regulations under CAA.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks that may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk. It is important to note that pesticides as defined in the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) are not included in the definition of a "chemical substance" when manufactured, processed, or distributed in commerce for use as a pesticide. Healthcare facilities may be subject to TSCA through:

- Lead hazard reduction regulations;
- Hexavalent chromium regulations under 40 CFR 749.68, replace hexavalent chromium compounds with phosphate based chemicals for water treatment in industrial cooling towers;
- Polychlorinated Biphenyls (PCB) hazard reduction regulations; and
- Asbestos hazard reduction regulations.

TSCA Regulations for Lead

- **National Lead Laboratory Accreditation Program** (TSCA Section 405(b)) establishes protocols, criteria, and minimum performance standards for laboratory analysis of lead in paint, dust, and soil.
- **Hazard Standards for Lead in Paint, Dust, and Soil** (TSCA Section 403) establishes standards for lead-based paint hazards and lead dust cleanup levels in most pre-1978 housing and child-occupied facilities.
- **Training & Certification Program for Lead-Based Paint Activities** (TSCA Section 402/404) ensures that individuals conducting lead-based paint abatement, risk assessment, or inspection are properly trained and certified, that training programs are accredited, and that these activities are

conducted according to reliable, effective, and safe work practice standards.

- **Pre-Renovation Education Rule** (TSCA Section 406(b)) ensures that owners and occupants of most pre-1978 housing are provided information concerning potential hazards of lead-based paint exposure before beginning certain renovations on that housing.

- **Lead-Based Paint Disclosure Rule** (TSCA Section 1018) requires disclosure of known lead-based paint and/or lead-based paint hazards by persons selling or leasing housing constructed before the phase-out of residential lead-based paint use in 1978.

TSCA Regulations for PCBs

The PCB regulations and requirements apply to both PCB waste materials and PCBs still in use. Because of potential harmful effects on human health and the environment, federal law banned U.S. production of PCBs as of July 2, 1979. However, PCB-containing materials may be present at facilities and PCB-laden wastes may be generated during renovations.

Items with a PCB concentration of 50 ppm or greater are regulated for disposal under 40 CFR Part 761. Some potential sources of PCBs include:

- Mineral-oil filled electrical equipment such as motors or pumps manufactured prior to July 2, 1979;

- Capacitors or transformers manufactured prior to July 2, 1979;

- Plastics, molded rubber parts, applied dried paints, coatings or sealants, caulking, adhesives, paper, Galbestos, sound-deadening materials, insulation, or felt or fabric products such as gaskets manufactured prior to July 2, 1979;

- Fluorescent light ballasts manufactured prior to July 2, 1979;

- Waste or debris from the demolition of buildings and equipment manufactured, serviced, or coated with PCBs; and

- Waste containing PCBs from spills, such as floors or walls contaminated by a leaking transformer.

The general requirements for handling PCB materials and equipment include: identifying and labeling the material, notifying EPA, properly storing the material, and properly disposing of the material.

TSCA Regulations for Asbestos

EPA and the OSHA have promulgated rules regulating asbestos production, use, and disposal. OSHA regulates private sector and some public sector employees' exposure to asbestos and specifies work practices and engineering controls for removing and handling asbestos. Along with EPA and OSHA, some states also have established asbestos requirements that extend the federal requirements. Asbestos programs implemented under TSCA include the following:

- Asbestos Hazard Emergency Response Act (AHERA), which regulates asbestos contained in schools and all public and commercial buildings including hospitals; requires the development of management plans; specifies work practices and engineering controls for removing and handling asbestos; and sets emissions limitations in schools after an abatement activity is completed. EPA Region 6 provides a list of suspected asbestos-containing materials at: *http://www.epa.gov/Region06/6pd/asbestos/asbmatl.htm*.

Typical Physical Features to Inspect for Lead-based Paint, PCBs, and Asbestos under TSCA

- PCB storage areas;
- Equipment, fluids, and other items used or stored at the facility containing PCBs. PCBs are most likely to be found in electrical equipment such as transformers, capacitors, and possibly fluorescent light ballasts (in older fixtures);
- Pipe, spray-on, duct, and troweled cementitious insulation and boiler lagging; and
- Ceiling and floor tiles.

EPA's TSCA Assistance Information Service, at (202) 554-1404 (e-mail: tsca-hotline@epa.gov), answers questions and distributes guidance pertaining to TSCA standards. The Service operates from 8:30 a.m. through 5:00 p.m., EST, excluding federal holidays. For more information on TSCA programs for lead, visit the web site www.epa.gov/lead/regulation.htm. EPA's PCB Homepage includes links to the regulatory text (40 CFR Part 761) as well as lists of approved PCB waste handlers: http://www.epa.gov/pcb/. EPA operates the Asbestos Ombudsman Clearinghouse/Hotline ((800) 368-5888, or (202) 260-0490) to provide general asbestos information. Also visit the EPA Asbestos Management & Regulatory Requirements web site (http://www.epa.gov/asbestos/help.html) for additional material.

Federal Insecticide, Fungicide and Rodenticide Act

FIFRA was first passed in 1947 and amended numerous times, most recently by the Food Quality Protection Act (FQPA) of 1996. FIFRA provides EPA with the authority to oversee, among other things, the registration, distribution, sale and use of pesticides. The Act applies to all types of pesticides, including insecticides, herbicides, fungicides, rodenticides and antimicrobials. FIFRA covers both intrastate and interstate commerce.

Product Registration

Under Section 3 of FIFRA, all pesticides (with few exceptions) sold or distributed in the United States must be registered by EPA. Pesticide registration is very specific and generally allows use of the product only as specified on the label. Each registration specifies the use site (i.e., where the product may be used) and the amount that may be applied. The person who seeks to register the pesticide must file an application for registration. The application process often requires either the citation or submission of extensive environmental, health, and safety data.

Use Restrictions

As a part of the pesticide registration, EPA classifies the product as unclassified, general use, or restricted use (40 CFR Section 152.160(a)). The Administrator may prescribe restrictions relating to the product's composition, labeling, or packaging. For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by, or under the direct supervision of, a certified applicator.

Good Laboratory Practices

EPA prescribes good laboratory practices under 40 CFR Part 160 for conducting studies that support research or marketing permits for pesticide products regulated by EPA. These practices are intended to assure the quality and integrity of the submitted research data.

Typical Physical Features to Inspect for under FIFRA

- Personnel protection equipment;
- Pesticide application equipment;
- Pesticide storage areas, including storage containers; and
- Cleaning disinfectants and labels.

Typical Records a EPA Inspector May Ask to Review under the FIFRA

- Records of pesticides purchased (purchase orders, inventory);
- Pesticide application records;
- Description of the pest control program;
- Certification status of pesticide applicators;

- Pesticide disposal manifests;
- Contract files; and
- Recent ventilation rating for pesticide fume hood and pesticide mixing/storage areas.

Antimicrobials

In healthcare settings, EPA regulates disinfectants that are used on environmental surfaces (housekeeping and clinical contact surfaces). Disinfectants intended for use on clinical contact surfaces (e.g., light handles, radiographic-ray heads, or drawer knobs) or housekeeping surfaces (e.g., floors, walls, or sinks) are regulated by EPA, under the authority of FIFRA. Under FIFRA, any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any pest, including microorganisms but excluding those in or on living man or animals, must be registered before sale or distribution. To obtain a registration, a manufacturer must submit specific data regarding the safety and the effectiveness of each product.

FIFRA requires users of products to follow the labeling directions on each product explicitly. The following statement appears on all EPA-registered product labels under the Directions for Use heading: "**It is a violation of federal law to use this product inconsistent with its labeling**." This means that users, including the healthcare industry, must follow the safety precautions and use directions on the labeling of each registered product. Not following the specified dilution, contact time, method of application, or any other condition of use is considered misuse of the product.

The Centers for Disease Control (CDC) recommends disinfecting environmental surfaces or sterilizing or disinfecting medical equipment, and medical facilities should use products approved by EPA unless no such products are available for use against certain microorganisms or sites. However, if no registered or approved products are available for a specific pathogen or use situation, medical facilities are advised to follow the specific guidance regarding unregistered or unapproved (e.g., off-label) uses for various chemical germicides. For example, no antimicrobial products are registered for use specifically against certain emerging pathogens (e.g., Norwalk virus), potential terrorism agents (e.g., variola major or *Yersinia pestis*), or Creutzfeldt-Jakob disease agents.

Microorganisms vary in their resistance to disinfection and sterilization, enabling CDC's designation of disinfectants as high-, intermediate-, and low-level, when compared with EPA's designated organism spectrum. However, exceptions to this general guide exist, and manufacturers' label claims and instructions should always be followed.

For more information on the use of hospital disinfectants, refer to: MMWR Recommendation and Report on Dental Infection Control Guidelines, (*http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5217a1.htm*) and Guidelines for Environmental Infection Control in Health-Care Facilities, (*http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5210a1.htm*).

Additional information on FIFRA and the regulation of pesticides can be obtained from a variety of sources, including EPA's Pesticide Program at

http://www.epa.gov/pesticides , EPA's Office of Compliance, Pesticide Compliance Assistance at http://www.epa.gov/compliance/assistance/pesticides/index.html, EPA's Office of Compliance Agriculture and Ecosystem Division at http://www.epa.gov/compliance/assistance/sectors/agriculture.html, or The National Agriculture Compliance Assistance Center, (888) 663-2155 or http://www.epa.gov/agriculture/ (e-mail: agcenter@epa.gov). Other sources include the National Pesticide Information Center, (800) 858-7378 or http://npic.orst.edu/, and EPA's Antimicrobial hotline , (703) 308-0127, operating weekdays from 9:00 a.m. to 4:00 p.m., EST, excluding federal holidays (e-mail: info_antimicrobial@epa.gov) or web site, http://www.epa.gov/oppad001/.

VI.B. Regulations by Waste Category

Table VI-2 lists the applicable regulations for each waste category.

Table VI-2: EPA Regulations by Waste Category

Waste Category	Specific Wastes Found in this Category[1]	Applicable Statute
Municipal Solid Waste	Cardboard, paper, boxboard, magazines, newspaper, metals (steel and aluminum), glass, plastics, food waste, leaf and yard waste, mixed materials, mattresses, furniture, pallets, carpet, packaging materials	RCRA, EPCRA, FIFRA
Biohazardous Waste, Regulated Medical Waste (RMW)	Sharps waste, blood and blood products, pathological waste, selected isolation wastes, cultures and stocks from laboratories, non-regulated chemotherapy waste, blood-soaked bandages, etc.	RCRA, CAA
Hazardous Waste	Solvents, selected pharmaceuticals, ethylene oxide (EtO), mercury-containing equipment or compounds, lead-containing equipment, hazardous chemicals	RCRA
Pressurized Containers	Gas cylinders, gas cartridges, aerosol cans, oxygen farms	RCRA
Universal Wastes	Mercury-containing thermostats, and spent fluorescent lamps and other hazardous lamps. Hazardous waste batteries, hazardous waste pesticides - recalled or sent to collection program	RCRA
Construction and Demolition Debris	Asbestos, mercury, lead, C&D debris	RCRA, CWA, CAA, TSCA
Wastewater	Potentially, any hazardous substance in any clinical area, oils, hydraulic fluid, chemical spills	CWA
Stormwater	Contaminated runoff from building, lawns, parking areas, underground storage tank areas, aboveground storage tank areas, and disturbed soils from construction sites	CWA, FIFRA

Table VI-2: EPA Regulations by Waste Category (Continued)

Waste Category	Specific Wastes Found in this Category[1]	Applicable Statute
Air Emissions	Air conditioning and refrigeration, boilers, medical waste incinerators, asbestos, paint booths, sterilization using ethylene oxide, emergency generators, anesthesia	CAA, EPCRA

[1]See Section III for more examples.

VI.C. Pending and Proposed Regulatory Requirements

The following pending and proposed regulations affect the healthcare industry:

Clean Water Act

EPA is working with dental offices to begin collecting dental amalgam before it enters the waste stream. As part of its pretreatment standards review process, EPA is reviewing industrial sources of mercury, including dental facilities, for potential technology-based options for controlling mercury discharges to wastewater treatment plants. In addition, the Agency is working with wastewater treatment plants to begin implementing best management practices for collecting mercury from other industrial sources, as well as modifying surface water discharge permits to reflect stricter requirements in mercury discharges. See EPA's Effluent Guidelines Program web site (*http://www.epa.gov/guide/)* for more information.

Clean Air Act

Ethylene Oxide (EtO)

Some hospitals use ethylene oxide as a sterilant for certain types of healthcare supplies and devices, primarily due to manufacturers' recommended practice to ensure the sterility of a product. Hospital sterilizers are one of 55 area source categories may be subject to Area Source Category NESHAP regulations. Go to: *http://www.epa.gov/ttn/atw/urban/arearules.html* for more information.

Resource Conservation and Recovery Act

Universal Waste Regulations

In June 2002, EPA proposed to add mercury-containing equipment to the universal waste list. The Universal Waste Rule allows facilities to streamline the waste management of certain widely generated hazardous wastes. The waste management requirements of universal wastes are less strict than those for other RCRA listed hazardous wastes. Visit the web site *www.epa.gov/epaoswer/hazwaste/id/univwast/regs.htm* for more information.

VI.D. Additional Applicable Regulations (Non-EPA Administered)

The following non-EPA administered environmental or wastes related regulations affect the healthcare industry:

Mercury Ordinances/Resolutions

Many states have passed ordinance and resolutions banning the manufacture or sale of mercury-containing items, such as thermometers, thermostats, and switches containing mercury.

"One Plan"/Integrated Contingency Plan

The "One Plan" (EPA HQ), also known as Integrated Contingency Plan (ICP), allows a facility to comply with multiple federal planning requirements by consolidating them into one functional emergency response plan. A number of statutes and regulations, administered by several federal agencies, include requirements for emergency response planning. A particular facility may be subject to one or more of the following federal regulations:

- EPA's Oil Pollution Prevention Regulation (SPCC and Facility Response Plan Requirements) - 40 CFR Part 112.7(d) and 112.20-.21;
- MMS's Facility Response Plan Regulation - 30 CFR Part 254;
- RSPA's Pipeline Response Plan Regulation - 49 CFR Part 194;
- USCG's Facility Response Plan Regulation - 33 CFR Part 154, Subpart F;
- EPA's Risk Management Programs Regulation - 40 CFR Part 68;
- OSHA's Emergency Action Plan Regulation - 29 CFR 1910.38(a);
- OSHA's Process Safety Standard - 29 CFR 1910.119;
- OSHA's HAZWOPER Regulation - 29 CFR 1910.120; and
- EPA's RCRA Contingency Planning Requirements - 40 CFR Part 264, Subpart D, 40 CFR Part 265, Subpart D, and 40 CFR 279.52.

In addition, facilities may also be subject to state emergency response planning requirements that this guidance does not specifically address. Facilities are encouraged to coordinate development of their ICP with relevant state and local agencies to ensure compliance with any additional regulatory requirements.

Visit the National Response Team's Integrated Contingency Plan Guidance (One Plan) web site for more information:
http://yosemite.epa.gov/oswer/ceppoweb.nsf/content/sta-loc.htm

Federal Hazardous Materials Transportation Law (HAZMAT)

The Department of Transportation (DOT), along with other agencies, regulates the transportation of hazardous materials (including certain medical wastes) under 49 CFR Parts 171-180. The regulations cover five areas: (1) hazardous materials definition/classification; (2) hazard communication; (3) packaging requirements; (4) operational rules; and (5) training. Biohazardous wastes are classified as a Class 6 DOT hazard.

The Hazardous Materials Information Center can be contacted at (800) HMR-4922 ((800) 467-4922) or (202) 366-4488, Monday through Friday from 9:00 am to 5:00 pm EST. Visit the HAZMAT web site at http://hazmat.dot.gov/hazhome.htm for additional material.

Nuclear Regulatory Commission (NRC)

The NRC, under authority of the Atomic Energy Act, regulates the use of nuclear by-product material in the fields of nuclear medicine, radiation therapy, and research. The nuclear by-product material is regulated by either the NRC or the state (currently 33 states have agreements with NRC to regulate the by-product material). The NRC issues licenses to authorized users and provides regulations and guidance for the use of nuclear by-product material. Note that radium, a radioactive material that has historically been used in brachytherapy and may be present in healthcare facilities, is not regulated by NRC. It is only regulated by states (although legislation is pending that would bring it under NRC authority).

Visit the NRC web site (http://www.nrc.gov) for more information.

Occupational Safety and Health Administration (OSHA)

OSHA provides regulatory standards to protect workers from injury. OSHA requirements that apply to healthcare facilities include the Bloodborne Pathogens Standard (1910.1030), Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard (1910.120), and Asbestos Standards (1910.1001) for any renovation work.

Visit the OSHA web site (http://www.osha.gov/) for more information. OSHA also has a Hospital eTool (http://www.osha.gov/SLTC/etools/hospital/mainpage.html) that addresses the following areas: administration, central supply, clinical services, dietary, emergency, engineering, heliport, housekeeping, ICU, laboratories, laundry, pharmacy, surgical suite, healthcare wide hazards, and other healthcare wide hazards.

U.S. Postal Service (USPS)

The Domestic Mail Manual, C023, as well as D.O.T. have certain requirements and restrictions for mailing or shipping hazardous pharmaceuticals to patients (i.e. consumer commodities that are hazardous). USPS also has regulations pertaining to mailing sharps, biological specimens, and other healthcare related materials.

Visit the USPS web site and reference the Domestic Mail Manual at (http://pe.usps.gov/) for more information.

National Institutes of Health, Centers for Disease Control (CDC)

The CDC publishes guidelines and recommendations for the healthcare industry on many areas including infection control, sterilization, hand hygiene, and immunizations.

Visit the CDC web site (www.cdc.gov) for more information. The CDC web site also has access to the National Institution of Safety and Health (NIOSH) publication, Preventing Occupational Exposure to Antineoplastic and Other Hazardous Drugs in Health Care Settings (http://www.cdc.gov/niosh/docs/2004-165/)

U.S. Department of Health and Human Services (HHS)

The HHS provides information on laws and regulations pertaining to healthcare from a variety of organizations including the Food and Drug Administration, Centers for Medicare and Medicaid Services, Health Resources and Services Administration, Substance Abuse and Mental Health Services Administration, and Indian Health Services.

Visit the HHS web site (www.hhs.gov) for more information.

VII. COMPLIANCE AND ENFORCEMENT HISTORY

VII.A. Background

Until recently, EPA focused much of its attention on ensuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-medium databases, extract compliance records, and match the records to individual facilities. IDEA uses the Facility Registry System (FRS) maintained Master Source ID identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRAInfo (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and OSHA.

The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

EPA has also developed Enforcement and Compliance History Online (ECHO). This database was developed in partnership with the Environmental Council of the States (ECOS), a national association representing state and territorial environmental commissioners. ECHO provides users detailed facility reports, which include:

- Federal and state compliance inspections;
- Environmental violations;
- Recent formal enforcement actions taken; and
- Demographic profile of surrounding area.

The data in ECHO covers a two-year period of information and includes information drawn from the following EPA databases:

- AIRS;
- PCS;
- RCRAInfo;
- Integrated Compliance Information System (ICIS);
- Facility Registry System (FRS); and
- U.S. Census Data.

The ECHO database can be found at *http://www.epa.gov/echo/index.html*.

VII.B. Compliance and Enforcement Description

This section discusses how EPA collects data on the historical compliance and enforcement activity of each sector. The Agency compiles compliance and enforcement records from its data systems to the facility level using the Facility Registry System's (FRS) Master Source ID, which links records from virtually any of EPA's data systems to a facility record. For each facility (i.e., Master Source ID), EPA uses the facility-level SIC code that is designated by IDEA, as follows:

1. If the facility reports to TRI, then the designated SIC code is the primary SIC reported in the most recent TRI reporting year.

2. If the facility does not report to TRI, the first SIC codes from all linked AFS, PCS, RCRAInfo, BRS ID/permits are assembled. If more than one permit/ID exists for a particular program, then only one record from that data system is used. The SIC code that occurs most often, if there is one, becomes the designated SIC code.

3. If the facility does not report to TRI and no SIC code occurs more often than others, the designated SIC code is chosen from the linked programs. If more than one permit/ID exists for a particular program, then only one record from that data system is used.

Note that EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the information presented in this section reflects the records of a subset of facilities within the sector that are well defined in EPA databases.

To compare the number of reported facilities in EPA's database to the total sector universe, most Sector Notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe in the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

This subsection contains four tables that summarize enforcement and compliance activities for the healthcare industry. Tables VII-1 and VII-2 look exclusively at the healthcare industry for the past five years. Tables VII-3 and VII-4 provide a general overview of

compliance and enforcement activities across each of the sectors discussed in a Sector Notebook, for the past five years. Following this introduction is a list defining each column in the tables presented in this section. The data in these tables solely reflect EPA, state, and local compliance assurance activity data that have been entered into EPA databases. EPA ran data queries, for the past five calendar years (February 19, 1998 to February 19, 2004). For up-to-date compliance data, visit the Sector Notebook data refresh web page at: *http://epa.gov/compliance/resources/publications/assistance/sectors/notebooks/data_refresh.html.*

Because most inspections focus on single-media requirements, the data presented in this section result from queries of single-medium databases. These databases do not provide data on whether inspections are state/local- or EPA-led. However, the table presenting the universe of violations generally measures EPA's and states' efforts within each media program. The presented data illustrate the variations across Regions for certain sectors[10]. This variation may result from state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Therefore, the data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

VII.C. Compliance and Enforcement Data Definitions

Facilities in Search (Tables VII-1, 2, 3, and 4) -- the number of the FRS-maintained Master Source IDs that were designated to the listed SIC code range.

Facilities Inspected (Tables VII-1, 2, 3, and 4) -- the number of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 24- or 60-month period.

Number of Inspections (Tables VII-1, 2, 3, and 4) -- the total number of inspections conducted in this sector. An inspection is counted each time it is entered into a single-medium database.

Average Months Between Inspections (Tables VII-1 and 3) -- the average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities with One or More Enforcement Actions (Tables VII-1 and 3) -- the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into federal and state actions in subsequent columns. EPA obtained these data for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple

[10] EPA Regions include the following states: 1 (CT, MA, ME, RI, NH, VT); 2 (NJ, NY, PR, VI); 3 (DC, DE, MD, PA, VA, WV); 4 (AL, FL, GA, KY, MS, NC, SC, TN); 5 (IL, IN, MI, MN, OH, WI); 6 (AR, LA, NM, OK, TX); 7 (IA, KS, MO, NE); 8 (CO, MT, ND, SD, UT, WY); 9 (AZ, CA, HI, NV, Pacific Trust Territories); 10 (AK, ID, OR, WA).

enforcement actions is counted only once in this column. All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions (Tables VII-1, 2, 3, and 4) -- the total number of enforcement actions identified for an industrial sector across all environmental statutes. In this column, a facility with multiple enforcement actions is counted multiple times (e.g., a facility with three enforcement actions counts as three).

State-Led Actions (Tables VII-1 and 3) -- the percentage of the total enforcement actions taken by state and local environmental agencies. Note that this number may not reflect the total number of state enforcement actions; some states extensively report enforcement activities to EPA to include in its data systems, while other states may use their own data systems.

Federal-Led Actions (Tables VII-1 and 3) -- the percentage of the total enforcement actions taken by EPA. This number includes cases that were referred to EPA from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement-to-Inspection Ratio (Tables VII-1 and 3) -- shows how often enforcement actions result from inspections; this number is presented for comparative purposes only. This number simply indicates historically how many enforcement actions can be attributed to inspection activity. This ratio includes and enforcement actions under the CWA (PCS), CAA (AFS) and RCRA. Inspections and enforcement actions from the TSCA/FIFRA/EPCRA databases are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio also does not account for enforcement actions arising from noninspection compliance monitoring activities (e.g., self-reported water discharges) under the CAA, CWA and RCRA.

Media Breakdown of Enforcement Actions and Inspections (Tables VII-2 and 4) -- four columns identify the proportion of total inspections and enforcement actions within EPA's Air, Water, Waste, and TSCA/FIFRA/EPCRA databases.

VII.D. Healthcare Industry Compliance History

Table VII-1 provides an overview of the reported compliance and enforcement data for the healthcare industry over the past five years (February 19, 1998 to February 19, 2004). These data are broken out by EPA Region, thereby permitting geographical comparisons. Observations from the data are listed below:

- Regions 2, 3, and 4 contain the most healthcare facilities and conducted the most inspections;
- Region 3 conducted, by far, the most inspections of healthcare facilities and had the lowest average time between inspections; and

- Region 2 had both the most enforcement actions, and the most enforcement actions per inspection.

Table VII-2 provides a more in-depth comparison between the healthcare industry and other sectors by breaking out the compliance and enforcement data by environmental statute for the same five-year period (February 19, 1998 to February 19, 2004). These data are also broken out by EPA Region, thereby permitting geographical comparisons. Observations from the data are listed below:

- The majority of inspections and actions are conducted under the CAA, followed by RCRA; and

- Regions 7 and 8 have only conducted enforcement actions under the CAA.

EPA's Region 2 office identified the following most common healthcare facility violations based on the inspections performed in their region, listed below.

Most Common CAA Healthcare Facility Violations

- Failure to use properly trained and accredited asbestos personnel;

- Failure to notify EPA of asbestos removal projects and to keep required documentation/records;

- Failure to properly dispose of asbestos debris;

- Failure to have CFC leak rate records for chillers and air conditioning units more than 50 pounds of charge;

- Failure to have EPA certified technicians for CFC-containing air conditioning and refrigeration systems;

- Failure to get boilers permitted with the state agency;

- Failure to apply for Title V operating permit;

- Failure to close parts washer lids when not in use; and

- Failure to include spray paint booths and parts degreasers in air permit.

Table VII-1: 5-Year Enforcement and Compliance Summary for the Healthcare Industry (SIC 8000), By Region

Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percentage of State Actions	Percentage of Federal Actions	Enforcement-to-Inspection Ratio
National	1,798	1,187	3,953	27	195	343	96%	4%	0.09
1	205	126	265	46	21	31	100%	0%	0.12
2	277	136	391	43	66	130	93%	7%	0.33
3	314	256	1,413	13	20	51	98%	2%	0.04
4	321	235	854	23	24	37	95%	5%	0.04
5	218	120	296	44	25	35	97%	3%	0.12
6	111	75	131	51	9	14	100%	0%	0.11
7	142	105	268	32	6	11	100%	0%	0.04
8	53	40	127	25	1	1	100%	0%	0.01
9	96	55	138	42	18	28	96%	4%	0.2
10	59	37	67	53	5	5	100%	0%	

Table VII-2: 5-Year Enforcement and Compliance Summary for the Healthcare Industry (SIC 8000), by Region and Statute

Region	Facilities In Search	Facilities Inspected	Number of Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/EPCRA	
					% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
National	1,798	1,187	3,953	343	78%	82%	0%	2%	21%	16%	1%	1%
1	205	126	265	31	81%	74%	0%	0%	19%	26%	0%	0%
2	277	136	391	130	71%	85%	2%	2%	24%	12%	3%	1%
3	314	256	1,413	51	88%	90%	0%	0%	12%	10%	0%	0%
4	321	235	854	37	73%	60%	0%	0%	27%	41%	0%	0%
5	218	120	296	35	83%	80%	2%	6%	15%	11%	0%	3%
6	111	75	131	14	45%	79%	0%	0%	55%	21%	0%	0%
7	142	105	268	11	80%	100%	0%	0%	20%	0%	0%	0%
8	53	40	127	1	67%	100%	0%	0%	33%	0%	0%	0%
9	96	55	138	28	70%	86%	0%	0%	29%	14%	1%	0%
10	59	37	67	5	43%	80%	0%	0%	52%	20%	4%	0%

Most Common RCRA Healthcare Facility Violations

- Failure to comply with hazardous waste generator regulations and lack of documentation;
- Failure to comply with Underground Storage Tank regulations and lack of documentation;
- Improper or lack of hazardous waste labeling;
- Failure to have waste batteries/fluorescent lamps stored in proper universal waste containers and labeled;
- No or infrequent weekly inspections of hazardous wastes storage/satellite areas;
- Open containers of hazardous wastes;
- Failure to have hazardous waste determinations on file for all wastes (i.e., some pharmaceutical wastes are classified as RCRA hazardous wastes);
- Failure to have procedures in place to ensure spent aerosol containers are empty before disposal as solid waste;
- Malfunctioning leak detection systems on underground storage tanks;
- Labeling of hazardous waste not done or incorrect;
- Improper disposal of chemotherapy drugs;
- Hazardous waste determination not done or incorrect;
- No or inadequate hazardous waste manifest;
- Disposal of hazardous waste down the drain;
- Improper management of expired pharmaceutical, paints, etc.;
- Lack of contingency plan;
- Lack of or inadequate training for employees in hazardous waste management;
- Failure to ensure that hazardous waste meets Land Disposal Restrictions;
- Failure to upgrade or close USTs by December 22, 1998; and

- Improper consolidation of wastes from nearby facilities.

Most Common CWA Healthcare Facility Violations

- No permit for noncompliance with wastewater discharges;
- Failure to know about local treatment plant sewer use regulations and possible prohibited discharges for indirect dischargers;
- No or inadequate secondary containment for storage tanks;
- Improper disposal down floor drains; and
- No Spill Prevention, Control and Countermeasure Plan.

Most Common EPCRA Healthcare Facility Violations

- Failure to report certain accidental chemical releases to the local authorities along with emissions data; and
- Storage of chemicals (i.e., heating oil and gasoline) on site above threshold amounts (hazardous chemicals above 10,000 lbs and/or extremely hazardous substances present at 500 lbs or the threshold planning quantity, whichever is lower).

Most Common FIFRA Healthcare Facility Violations

- Misuse of a registered pesticide product;
- Use of an unregistered product;
- Lack of proper records concerning pest control application within the hospital and/or on the hospital grounds; and
- Failure to report pesticide poisonings either occurring within the hospital or of admitted patients.

Common Violations and Problems Found at Hospitals for TSCA Issues

TSCA inspectors are primarily interested in any PCBs and lead-based paint at hospitals. Typical staff residential area lead paint violations/issues are:

- Failure to notify residents of lead paint in building or lack of knowledge of any lead hazard; and

- Failure to provide EPA's pamphlet, "Protect Your Family from Lead in Your Home" as required under 40 CFR Part 745.107(a)(1) (see *http://www.epa.gov/opptintr/lead/leadpdfe.pdf*).

Visit the Healthcare Environmental Resource Center at *http://www.herc.org* for plain language explanations on how to comply with environmental regulations and to learn about pollution prevention opportunities. The Center web site also links to state rules and permitting contacts. Its resource sections contain selected compliance assistance and pollution prevention tools. If you don't have access to the Internet, refer to Section VI and to the Bibliography in Section IX.B for additional resources.

VII.E. Comparison of Enforcement Activity Among Selected Industries

Table VII-3 compares the compliance history of the healthcare sector to the other industries covered by the industry Sector Notebooks. Observations from these five years of data are listed below:

- Sixty-six percent of healthcare facilities have been inspected over the past five years, which is approximately equal to the average (62 percent) for all other sectors listed;
- The inspected healthcare facilities have been inspected an average of three times each; and
- The healthcare, ground transportation, and oil and gas extraction industries have the highest percentage of state-led enforcement actions (96 percent).

Tables VII-4 provides a more in-depth comparison between the healthcare industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in Table VII-3, the data cover the last five years. Observations from the data are listed below:

- The majority of inspections and actions are conducted under the CAA, followed by RCRA;
- The healthcare industry has a higher percentage of CAA inspections (78 percent) than the average of the other sectors (60 percent); and
- The healthcare industry has one of the lowest percentages of CWA inspections and actions of any of the sectors listed in these tables.

Table VII-3: 5-Year Enforcement and Compliance Summary for Selected Industries

Sector	Facilities In Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percentage of State-Led Actions	Percentage of Federal-Led Actions	Enforcement-to-Inspection Ratio
Healthcare (SIC Code 8000)	**1,798**	**1,187**	**3,953**	**27**	**195**	**343**	**96%**	**4%**	**0.09**
Aerospace	764	526	2,704	17	246	238	65%	35%	0.09
Ag Chem Pesticide & Fertilizer	585	345	2,123	17	138	107	57%	43%	0.05
Ag Crop Production	131	69	165	48	12	7	86%	14%	0.04
Ag Livestock Production	53	17	58	55	14	28	11%	89%	0.48
Air Transportation	428	211	619	41	80	62	71%	29%	0.1
Dry Cleaning	3,345	1,620	2,944	68	232	178	92%	8%	0.06
Electronics & Computer	1,852	906	2,486	45	286	196	75%	25%	0.08
Fossil Fuel Elec Power Gen	3,520	2,543	18,758	11	1,170	1,582	78%	22%	0.08
Ground Transportation	4,970	3,338	13,612	22	1,084	880	96%	4%	0.06
Inorganic Chemical	1,007	629	5,291	11	352	414	79%	21%	0.08
Iron and Steel	683	480	6,060	7	312	536	78%	22%	0.09
Lumber & Wood Products	3,038	2,045	10,728	17	872	814	85%	16%	0.08
Metal Casting	1,346	797	3,549	23	348	340	79%	21%	0.1
Metal Fabrication	8,279	5,092	16,568	30	2,138	1,716	76%	24%	0.1
Metal Mining	281	183	980	17	70	71	85%	16%	0.07
Motor Vehicle Assembly	1,886	1,211	5,531	20	500	448	77%	23%	0.08
Non-Fuel, Non-Metal Mining	3,778	2,005	9,291	24	522	524	95%	6%	0.06
Nonferrous Metals	531	327	2,968	11	242	395	88%	12%	0.13
Oil & Gas Extraction	2,783	1,681	6,371	26	1,120	949	96%	4%	0.15
Organic Chemical	1,050	787	8,483	7	558	846	73%	27%	0.1
Petroleum Refining	438	297	5,405	5	352	1,335	69%	31%	0.25
Pharmaceutical	572	414	2,108	16	174	199	84%	16%	0.09
Plastic Resins & Fibers	709	502	4,637	9	344	444	85%	15%	0.1
Printing	2,384	1,460	4,913	29	476	435	90%	10%	0.09
Pulp and Paper	566	467	5,830	6	336	498	90%	10%	0.09

Table VII-3: 5-Year Enforcement and Compliance Summary for Selected Industries (Continued)

Sector	Facilities In Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percentage of State-Led Actions	Percentage of Federal-Led Actions	Enforcement-to-Inspection Ratio
Rubber and Plastic	3,823	2,294	9,239	25	962	787	90%	10%	0.09
Shipbuilding & Repair	235	168	870	16	96	83	81%	19%	0.1
Stone Clay Glass&Concrete	3,388	2,013	12,190	17	876	930	89%	11%	0.08
Textiles	1,226	814	3,859	19	304	310	87%	13%	0.08
Water Transportation	269	158	384	42	40	36	89%	11%	0.09
Wood Furniture & Fixtures	1,652	1,047	5,515	18	440	382	89%	12%	0.07

Table VII-4: 5-Year Enforcement and Compliance Summary by Statute for Selected Industries

Sector	Facilities In Search	Facilities Inspected	Number of Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
					% of Total Inspections	% of Total Enforcement Actions	% of Total Inspections	% of Total Enforcement Actions	% of Total Inspections	% of Total Enforcement Actions	% of Total Inspections	% of Total Enforcement Actions
Healthcare (SIC Code 8000)	**1,798**	**1,187**	**3,953**	**343**	**78%**	**82%**	**0%**	**2%**	**21%**	**16%**	**1%**	**1%**
Aerospace	764	526	2,704	238	52%	43%	3%	3%	44%	51%	0%	3%
Ag Chem Pesticide & Fertilizer	585	345	2,123	107	55%	34%	12%	8%	27%	31%	6%	27%
Ag Crop Production	131	69	165	7	50%	71%	0%	0%	46%	29%	4%	0%
Ag Livestock Production	53	17	58	28	53%	89%	0%	7%	47%	0%	0%	4%
Air Transportation	428	211	619	62	38%	23%	1%	2%	61%	74%	0%	2%
Dry Cleaning	3,345	1,620	2,944	178	26%	35%	0%	0%	74%	65%	0%	0%
Electronics & Computer	1,852	906	2,486	196	31%	14%	4%	5%	64%	67%	1%	15%
Fossil Fuel Elec Power Gen	3,520	2,543	18,758	1,582	75%	88%	18%	8%	6%	3%	0%	1%
Ground Transportation	4,970	3,338	13,612	880	78%	76%	0%	1%	21%	23%	0%	1%
Inorganic Chemical	1,007	629	5,291	414	48%	54%	13%	10%	37%	31%	1%	6%
Iron and Steel	683	480	6,060	536	61%	67%	13%	10%	26%	20%	0%	3%
Lumber & Wood Products	3,038	2,045	10,728	814	75%	76%	1%	0%	24%	23%	1%	1%
Metal Casting	1,346	797	3,549	340	60%	59%	3%	2%	36%	33%	1%	6%
Metal Fabrication	8,279	5,092	16,568	1,716	45%	46%	2%	1%	52%	46%	1%	7%
Metal Mining	281	183	980	71	56%	52%	28%	39%	15%	7%	1%	1%
Motor Vehicle Assembly	1,886	1,211	5,531	448	60%	56%	1%	1%	38%	40%	0%	3%
Non-Fuel, Non-Metal Mining	3,778	2,005	9,291	524	97%	99%	1%	0%	2%	1%	0%	0%
Nonferrous Metals	531	327	2,968	395	64%	70%	9%	5%	27%	22%	0%	2%
Oil & Gas Extraction	2,783	1,681	6,371	949	97%	98%	0%	1%	3%	2%	0%	0%
Organic Chemical	1,050	787	8,483	846	47%	55%	12%	13%	39%	28%	2%	5%
Petroleum Refining	438	297	5,405	1,335	57%	83%	15%	6%	27%	10%	1%	1%
Pharmaceutical	572	414	2,108	199	40%	49%	7%	8%	52%	37%	1%	6%
Plastic Resins & Fibers	709	502	4,637	444	51%	59%	19%	17%	29%	22%	1%	3%
Printing	2,384	1,460	4,913	435	65%	66%	0%	0%	34%	33%	1%	1%
Pulp and Paper	566	467	5,830	498	67%	75%	26%	18%	7%	4%	0%	3%
Rubber and Plastic	3,823	2,294	9,239	787	71%	73%	1%	0%	27%	23%	1%	5%
Shipbuilding & Repair	235	168	870	83	59%	34%	6%	8%	35%	57%	1%	1%
Stone Clay Glass&Concrete	3,388	2,013	12,190	930	85%	87%	1%	1%	13%	10%	1%	2%

Table VII-4: 5-Year Enforcement and Compliance Summary by Statute for Selected Industries (Continued)

Sector	Facilities In Search	Facilities Inspected	Number of Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
					% of Total Inspections	% of Total Enforcement Actions	% of Total Inspections	% of Total Enforcement Actions	% of Total Inspections	% of Total Enforcement Actions	% of Total Inspections	% of Total Enforcement Actions
Textiles	1,226	814	3,859	310	76%	59%	12%	23%	12%	14%	1%	3%
Water Transportation	269	158	384	36	42%	50%	1%	0%	56%	50%	1%	0%
Wood Furniture & Fixtures	1,652	1,047	5,515	382	76%	75%	0%	1%	23%	23%	0%	2%

VII.F. Review of Major Legal Actions

This subsection discusses major legal cases and pending litigation within the healthcare industry. Following are several press releases that discuss recent major cases regarding healthcare facilities:

DEPARTMENT OF VETERANS AFFAIRS AGREES TO $133,000 SETTLEMENT FOR LEAD PAINT DISCLOSURE VIOLATIONS IN MAINE AND MASSACHUSETTS

EXCERPTS FROM: EPA Region 1 Press Release, April 6, 2004, Release # 04-04-04

BOSTON - The U.S. Department of Veterans Affairs has agreed to pay a $10,068 penalty and perform environmental projects worth $123,050 to settle claims by the U.S. Environmental Protection Agency that it failed to properly inform tenants about potential lead hazards at employee housing provided by the department.

The three EPA complaints allege violations of the federal Lead Disclosure Rule for employee housing at VA Medical Centers in Northampton and Bedford, Mass. and Togus, Maine. The three medical centers include a total of about 41 on-site housing units, which the VA leases to employees and their families. Settlement of this case represents the first time a federal facility has paid a penalty for violations of the Lead Disclosure Rule.

In addition to paying the fine, the VA agreed to assign a person to be responsible for environmental compliance at each facility, and to implement a lead-based paint abatement project in employee housing at a total cost of $123,050. Of the case penalty, the Bedford facility will pay $3,080; the Togus facility will pay $3,908; and the Northampton facility will pay $3,080. This case abates health risks posed by lead paint in 16 units of employee housing divided between the three locations and addresses the facilities' underlying barriers to compliance.

The case is among numerous lead-related civil and criminal cases EPA New England has taken to make sure landlords and property owners and managers are complying with the federal Lead Disclosure Rule. EPA New England's work to implement the Residential Lead-Based Paint Hazard Reduction Act has included more than 150 inspections around New England, as well as numerous compliance assistance workshops.

Low-level lead poisoning is widespread among American children, affecting as many as three million children under the age of six, with lead paint the primary cause. Elevated lead levels can trigger learning disabilities, decreased growth, hyperactivity, impaired hearing and even brain damage. Lead is also harmful to adults. Adults can suffer from difficulties during pregnancy, other reproductive problems, high blood pressure, digestive problems, nerve disorders, memory and concentration problems, and muscle and joint pain.

EPA ORDERS CLOSURE OF MEDICAL WASTE INCINERATORS AT GUAM MEMORIAL HOSPITAL

FOR RELEASE: June 2004

HONOLULU -- In response to an order from the U.S. Environmental Protection Agency, the Guam Memorial Hospital Authority has shut down one of its medical waste incinerators and will soon shut down a second in order to meet federal Clean Air Act standards.

Guam Memorial Hospital Authority has agreed to comply with the EPA's order by ceasing to operate its incinerators and putting an alternative medical waste treatment method into place.

The first of two incinerators was shut down on May 18. The second incinerator was switched to emergency back-up status on June 11 and will be permanently shut down by Nov. 30. The EPA determined that both incinerators were violating the emissions standards set by the Clean Air Act.

"It is critical that medical waste incinerators meet all of the required emission standards to protect the public's health," said Deborah Jordan, the EPA's air division director for the Pacific Southwest region. "Developing alternative medical waste treatment will further ensure clean air and proper disposal of medical waste for Guam's residents."

During the initial source tests, one of the incinerators violated the particulate matter, dioxins and furans, hydrogen chloride and lead emissions limits, while the second incinerator violated the particulate matter and hydrogen chloride emission limits. At that time, Guam Memorial Hospital Authority also failed to submit to the EPA the required waste management plan and necessary incinerator operating parameters and other required data for both incinerators.

In response to the order, Guam Memorial Hospital Authority has given the EPA a plan to transport all hospital, medical and infectious waste to a commercial medical waste treatment and disposal facility while the hospital develops an alternative waste treatment system.

The EPA's order also requires the Guam Memorial Hospital Authority to:

- Provide to the EPA a copy of its waste management plan which will include plans to separate solid waste from medical waste and other waste minimization opportunities; and

- Complete the shut down of both incinerators by Nov. 30 and complete final removal and proper disposal of the two incinerators by Dec. 30.

All medical waste incinerators need to be permitted and have the necessary air pollution controls to meet all Clean Air Act standards. Medical waste can be a source of

pollution from the pathological and biological waste, along with any chemicals produced during incineration from plastics and other medical waste materials.

SLOAN-KETTERING FINED FOR FAILURE TO PROPERLY MANAGE HAZARDOUS WASTE

FOR RELEASE: Tuesday, January 27, 2004

New York, N.Y. – The U.S. Environmental Protection Agency (EPA) announced today that it has cited Memorial Sloan-Kettering Cancer Center in New York City for violating numerous hazardous waste management requirements. The Agency is seeking full compliance and $214,420 in penalties for the violations.

"Hospitals and healthcare facilities must consider the proper handling of hazardous waste an integral part of their mandates to protect people's health," said Jane M. Kenny, EPA Regional Administrator. "Chemotherapy waste is an especially toxic waste produced by many medical facilities. Hazardous waste regulations are in place to help to ensure that facilities like Sloan-Kettering do not release these or other toxic chemicals into the environment.

EPA discovered violations of the Resource Conservation and Recovery Act (RCRA) at Sloan- Kettering during a March 2003 inspection. They included improper storage and disposal of chemotherapy and dental solid wastes, as well as a general failure to determine whether they were hazardous wastes. Sloan-Kettering has 30 days to respond to the complaint.

In 2002, EPA started the Hospital and Healthcare Initiative to help hospitals and healthcare facilities comply with environmental regulations as part of a larger EPA voluntary audit policy. The Agency established the policy to encourage prompt disclosure and correction of environmental violations, safeguarding people's health and the environment. Many hospitals and healthcare facilities were not aware of their responsibilities under various environmental laws or had failed to implement effective compliance strategies. As part of the initiative, EPA sent letters to 480 facilities in New Jersey, New York, Puerto Rico and the U.S. Virgin Islands and held free workshops to help hospitals comply. In addition, the Agency established a web site that provides information about their duties under the law, and warned hospitals that EPA inspections of their facilities - with risk of financial penalties - were imminent.

Hospitals that wish to take advantage of the Agency's voluntary self-audit program can investigate and disclose environmental violations to EPA and, if certain conditions are met, receive a partial or complete reduction in financial penalties. To date, fourteen healthcare organizations have entered into voluntary self-audit disclosure agreements with EPA. The Agency is continuing to conduct inspections. More information about the healthcare initiative can be found on EPA's web site at: *www.epa.gov/Region2/healthcare/index.html* and about hazardous waste regulation in general at: *www.epa.gov/epaoswer/osw/index.htm*.

EPA FINES NASSAU HEALTH CARE CORPORATION FOR VIOLATING HAZARDOUS WASTE REGULATIONS

FOR RELEASE: Monday, October 20, 2003

New York, N.Y. – The U.S. Environmental Protection Agency (EPA) announced today that it will seek $279,900 in penalties from the Nassau Health Care Corporation Nassau University Medical Center in East Meadow, New York for violating numerous requirements of the federal and New York State hazardous waste regulations. The medical research, diagnostic and treatment facility must comply with all hazardous waste management requirements under the Resource Conservation and Recovery Act (RCRA).

"Hazardous waste regulations help to ensure that facilities like Nassau Health do not release toxic chemicals into the environment and protect workers, patients and visitors at the hospital," said EPA Regional Administrator Jane M. Kenny. "Many toxic compounds easily contaminate air, ground or water and exposure can cause or aggravate many illnesses. Though there were no releases in this case, it is essential that companies with hazardous chemicals in their waste follow EPA and state regulations very carefully to ensure that they don't endanger people or the environment."

The discovery of violations at Nassau Health grew out of EPA inspections of the facility this past winter. These violations included storage or abandonment of several types of solid waste and chemicals, and failure to determine whether or not they were hazardous wastes. In addition, the hospital did not have a permit to store hazardous waste, and did not meet the protective management requirements needed to be exempt from a permit. Hazardous waste containers were not identified with the required markings or inspected regularly; emergency response agencies were not notified of hazardous waste being stored; and the hospital did not minimize the possibility of fire, explosion or unplanned release of hazardous substances into the environment. Finally, a number of hospital personnel responsible for hazardous waste management were not trained in how to handle it, and no hazardous waste emergency response plan was in place. Since the inspection, Nassau Health has been correcting the violations. The company has 30 days to respond to the complaint.

Nassau Health could have avoided this enforcement action by taking advantage of EPA's Hospitals and Healthcare Initiative. EPA Region 2 started the Hospital and Healthcare Initiative in the fall of 2002 to help hospitals and healthcare facilities comply with environmental regulations as part of a larger EPA Voluntary Audit Policy. The Agency established the policy to encourage prompt disclosure and correction of environmental violations, safeguarding human health and the environment. Many hospitals and healthcare facilities were not aware of their responsibilities under various environmental laws or failed to implement effective compliance strategies. As part of the initiative, EPA sent letters to 480 facilities in New Jersey, New York, Puerto Rico and the U.S. Virgin Islands and held free workshops to help hospitals comply. In addition, the Agency established a web site that provides information about their duties under the law, and warned hospitals that EPA inspections of their facilities - with risk of financial penalties - were imminent.

Hospitals can take advantage of the Agency's Voluntary Audit Policy, through which they can investigate and disclose environmental violations to EPA and, as a compliance incentive, receive a partial or complete reduction in financial penalties. To date, eleven hospitals have entered into voluntary self-audit disclosure agreements with EPA.

More information about hazardous waste regulations can be found on EPA's web site at: *http://www.epa.gov/epaoswer/osw/index.htm*.

NORTH SHORE PAYS FINES FOR VIOLATING FEDERAL HAZARDOUS WASTE HANDLING RULES

FOR RELEASE: Thursday, June 12, 2003

NEW YORK, N.Y. – North Shore University Hospital on Community Drive in Manhasset has agreed to pay $40,000 in penalties to the federal government for violations of the Resource Conservation and Recovery Act (RCRA) hazardous waste regulations, the U.S. Environmental Protection Agency (EPA) announced today.

EPA Regional Administrator Jane M. Kenny explained. "The only way hospitals and other healthcare facilities can ensure that wastes that have the potential to harm people and the environment are properly handled is to strictly adhere to federal hazardous waste rules."

As part of a region-wide initiative to bring hospitals into compliance with federal rules, EPA is inspecting healthcare facilities in New York, New Jersey, Puerto Rico and the U.S. Virgin Islands. The discovery of the violations at North Shore Hospital grew out of EPA inspections of the facility in April and May of 2002.

EPA issued a complaint last year against North Shore hospital alleging it failed to determine if spent fluorescent bulbs and chemotherapy waste were hazardous prior to disposal, and had improperly documented the transport of hazardous waste. The Agency also cited North Shore for failing to properly label storage drums containing hazardous waste and to minimize the risk of explosion, fire and release that could have affected people's health and the environment. As part of the settlement between the facility and EPA, the facility agreed to take corrective actions that would prevent any recurrence of the violations in the future.

EPA operates a Voluntary Audit Policy, through which the Agency can substantially reduce civil penalties for those that voluntarily disclose and promptly correct violations that are identified through self-policing and meet certain other specified conditions, except in cases involving serious harm to public health or the environment. In most cases, the punitive component of the penalty may be fully eliminated, but EPA would still be able to collect any economic benefit as a result of non-compliance.

EPA PROPOSES TO FINE PONCE HOSPITAL FOR ILLEGAL DISCHARGE

FOR RELEASE: Wednesday, November 19, 2003

New York, N.Y. – The U.S. Environmental Protection Agency (EPA) has proposed a $137,500 penalty against Quality Health Services of Puerto Rico, Inc. (Hospital San Cristobal) for discharging wastewater to a small creek, a tributary to the Rio Inabon, in violation of the federal Clean Water Act. The EPA issued a complaint based on the hospital's continuing failure to comply with the requirements of its wastewater discharge permit.

"Wastewater discharge permits protect public health and the environment," said EPA Regional Administrator Jane M. Kenny. "The hospital has been out of compliance since February 2000. As a healthcare facility, Hospital San Cristobal should understand the importance of properly managing its waste."

The September 30, 2003 complaint charges that Quality Health Services violated the requirements of its National Pollutant Discharge Elimination System (NPDES) permit, issued under the Clean Water Act. In March 2003, EPA inspected the hospital and ordered Quality Health Services to comply with the requirements of its NPDES permit. However, Quality Health Services allegedly continued to violate the Clean Water Act (for a total of 226 times from February 2000 through May 2003) with its discharge of sanitary wastewaters from the hospital's wastewater treatment plant. Specifically, the discharge exceeded permit limitations for ammonia, biochemical oxygen demand, color, fecal coliform, flow, fluoride, nitrate-nitrite, phenolics, phosphorus, silver, sulfide, surfactants and zinc. Under federal regulations, Quality Health Services has the right to request a hearing on the proposed penalty.

NEW YORK PRESBYTERIAN HOSPITAL

BASED ON NOVEMBER 2004 PRESS RELEASE

New York Presbyterian Hospital was charged with failing to provide tenants, including pregnant women and families with young children, with the required lead paint hazard information (i.e., failing to provide a lead warning statement, statement disclosing any knowledge of lead-based paint, and list of any existing records or reports pertaining to lead-based paint, nor obtaining a statement by the lessee of receipt of a lead hazard information pamphlet.) These failures are violations of 42 U.S.C. Section 4852d(b)(5) and § 409 of TSCA, 15 U.S.C. § 2689.

Lead poisoning presents an environmental health hazard for young children living in apartments constructed before 1978, due to the potential chipping or peeling of lead paint, or lead-contaminated dust. New York Presbyterian Hospital owned and leased at least twenty-nine housing units to families of physicians at their facility in White Plains, New York. Region 2 suggested possible activities that could be undertaken as Supplemental Environmental Projects, and New York Presbyterian Hospital submitted a proposal for a SEP that involved exterior maintenance and repair, but the parties were unable to reach agreement on an appropriate SEP. New York Presbyterian Hospital entered into a cash settlement with EPA for $248,000, which is

the largest monetary settlement in the history of the Lead-based Paint Disclosure Program. On July 10, 2003, the Regional Administrator signed the Final Order memorializing the settlement in the Consent Agreement and Final Order. (T. Bourbon/L. Livingston)

EPA FINES ATLANTIC HEALTH SYSTEMS INC. FOR FAILURE TO PROPERLY MANAGE HAZARDOUS WASTE

FOR RELEASE: Tuesday, November 25, 2003

New York, N.Y. -- The U.S. Environmental Protection Agency (EPA) announced today that it will seek $64,349 in penalties from Atlantic Health System Inc., owner and operator of Mountainside Hospital in Montclair, New Jersey. The Agency cited the company for violating numerous hazardous waste management requirements under the Resource Conservation and Recovery Act (RCRA).

"Hospitals and healthcare facilities should consider the proper handling of hazardous waste as an integral part of their mandates to protect people's health," said Jane M. Kenny, EPA Regional Administrator."We are pleased that Mountainside Hospital has recognized its responsibility to its patients, employees and neighbors, and is taking action to correct the violations."

EPA discovered the violations at Mountainside Hospital during an April 2003 inspection. The violations included improper storage or disposal of several types of solid waste, and failure to determine whether they were hazardous wastes. In addition, the hospital did not have a permit to store hazardous waste and did not meet the protective management requirements needed to be exempt from a permit. Hazardous waste containers were not clearly identified with the required markings or inspected regularly, and emergency response information was not posted. Mountainside is working to correct the violations. Its parent company, Atlantic Health, has 30 days to respond to the complaint.

In 2002, EPA started the Hospital and Healthcare Initiative to help hospitals and healthcare facilities comply with environmental regulations as part of a larger EPA voluntary audit policy. The Agency established the policy to encourage prompt disclosure and correction of environmental violations, safeguarding people's health and the environment. Many hospitals and healthcare facilities were not aware of their responsibilities under various environmental laws or had failed to implement effective compliance strategies. As part of the initiative, EPA sent letters to 480 facilities in New Jersey, New York, Puerto Rico and the U.S. Virgin Islands and held free workshops to help hospitals comply. In addition, the Agency established a web site that provides information about their duties under the law, and warned hospitals that EPA inspections of their facilities - with risk of financial penalties - were imminent.

Hospitals that wish to take advantage of the Agency's voluntary self-audit program can investigate and disclose environmental violations to EPA and, if certain conditions are met, receive a partial or complete reduction in financial penalties. To date, eleven hospitals have entered into voluntary self-audit disclosure agreements with EPA. The Agency is continuing to conduct inspections.

YALE-NEW HAVEN HOSPITAL ACCEPTS EPA PLAN FOR ENVIRONMENTAL AUDIT

Yale-New Haven Hospital and EPA say they have reached an agreement under which the hospital will voluntarily carry out a comprehensive environmental audit. The agreement between EPA Region I and the hospital in New Haven, Conn., is the first of its kind to be signed in New England and is part of an agency effort to improve hospital compliance with environmental laws. EPA Region I launched its hospital initiative earlier this year, citing the experience of EPA's New York/New Jersey regional office, which took enforcement actions against several hospitals after significant noncompliance was found during inspections of hospital facilities.
Source: *http://pubs.bna.com/ip/BNA/den.nsf/is/a0b0d4k1d7*

VIII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights organizations, resources, and the voluntary activities being undertaken by the healthcare sector, public agencies, and nongovernmental organizations to improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations.

VIII.A. Healthcare Related Programs and Activities

Healthcare Environmental Resource Center (Compliance Assistance Center)

Using an EPA grant the National Center for Manufacturing Sciences with the cooperation of the American Hospital Association, the American Nurses Association, and EPA, via the Hospitals for a Health Environment (H2E) program and other stakeholders, is creating an on-line compliance assistance center (or Healthcare Environmental Resource Center - HERC) serving the healthcare industry. The HERC will address issues relevant to hospitals, ambulatory clinics, and other specialized medical facilities. It will serve as a first stop for environmental compliance and pollution prevention information for the healthcare industry. Among its many compliance assistance and pollution prevention features, the HERC will include plain language explanations of applicable regulations and feature links to state and local permitting agencies where users can find information on local regulations and contacts. Look for the Healthcare Environmental Resource Center at *www.HERCenter.org*.

Hospitals for a Healthy Environment (H2E)

Hospitals for a Healthy Environment (H2E) is a voluntary program jointly sponsored by the EPA, the American Hospital Association, the American Nurses Association, and Health Care Without Harm. The primary goal of the H2E effort is to educate healthcare professionals about pollution prevention opportunities in hospitals and healthcare systems and make significant reductions in mercury-containing healthcare waste, and waste volume overall. Through activities such as the development of best practices, model plans for total waste management, resource directories, and case studies, the project hopes to provide hospitals and healthcare systems with enhanced tools for minimizing the volumes of waste generated and the use of persistent, bioaccumulative, and toxic chemicals. Such reductions are beneficial to the environment and health of our communities. Furthermore, improved waste management practices will reduce the waste disposal costs incurred by the healthcare industry. For more information, see the web site at *http://www.h2e-online.org/*.

Resource Conservation Challenge (RCC)

EPA's Resource Conservation Challenge (www.epa.gov/rcc) is a voluntary, joint effort between EPA, businesses, and communities. RCC aims to find flexible, yet more protective ways of improving waste reduction, public health, and the environment. As part of the Resource Conservation Challenge, EPA is asking the hospital industry to develop projects for the

reuse and recycling of hospital items and the reduction of waste. For more information, see the web site at *http://www.epa.gov/epaoswer/osw/conserve/clusters/hospital.htm*.

Lead needed to protect healthcare workers from CatScan radiation, mercury in ultraviolet lamps, and residual or expired pharmaceuticals are just a few examples of the hospital waste that can harm the environment if disposed of improperly. EPA's RCC is committed to supporting projects that:

- Reduce the volume of nonhazardous solid waste, including paper, packaging, yard waste, food waste, and electronic equipment, from the healthcare industry and promote its recycling and safe reuse;
- Virtually eliminate all mercury waste from the healthcare industry waste stream;
- Reduce the volume of other toxic chemicals; and
- Improve the management of pharmaceutical waste by reducing the amount of expired/unused pharmaceuticals that are disposed of in landfills.

Performance Track

Performance Track is a public/private partnership recognizing top environmental performance among participating U.S. facilities of all types, sizes, and complexity, public and private. Program partners are providing leadership in many areas, including preventing pollution at its source and implementing environmental management systems. Currently, the program has approximately 300 members and welcomes all qualifying facilities. Applications are accepted twice a year: February 1-April 30 and August 1-October 31. For more information, contact the Performance Track hotline at (888) 339-PTRK or visit the web site at *www.epa.gov/performancetrack*.

EPA Audit Policy

EPA encourages companies with multiple facilities to take advantage of the Agency's Audit Policy (Incentives for Self-Policing: Discovery, Disclosure, Correction and Prevention of Violations, 65 Fed. Reg. 19618 (April 11, 2000)) to conduct audits and develop environmental compliance systems. The Audit Policy eliminates gravity-based penalties for companies that voluntarily discover, promptly disclose, and expeditiously correct violations of federal environmental law. More information on EPA's Audit Policy can be obtained from the web site at *http://www.epa.gov/compliance/resources/policies/incentives/auditing/index.html*. EPA Region 2 (NY, NJ, PR, VI) has been actively promoting use of the policy; see voluntary audit policy at *http://www.epa.gov/region02/healthcare/*.

Office of Solid Waste and Emergency Response (OSWER) Innovations Pilot

The Office of Solid Waste and Emergency Response (OSWER) initiated a series of innovative pilots to test new ideas and strategies for environmental and public health protection to find creative approaches to waste minimization. For additional information on OSWER Innovations Pilots, visit the EPA OSWER Innovations web site at *www.epa.gov/oswer/iwg*.

Expanding Pharmaceutical Waste Management in Hospitals

Hospitals for a Healthy Environment is partnering with EPA Region 1, Dartmouth-Hitchcock Medical Center, New Hampshire Department of Environmental Services, New Hampshire Hospital Association, and H2E Champion, PharmEcology Associates, to pioneer pharmaceutical management techniques that ensure regulatory compliance, implement best management practices, and identify and implement waste minimization opportunities. Baseline data on costs and quantities of end-of-life pharmaceuticals will be compiled and evaluated. This information will be used to assess where pharmaceuticals are being discarded, how much is being wasted, and how wasting can be minimized. Based on the results of the baseline assessment, the pilot will develop best management practices incorporating waste reduction activities. A blueprint will be developed providing a step-by-step approach to program implementation and lessons learned. For more detailed information on the pharmaceutical pilot, visit H2E's web site at *www.h2e-online.org*.

Collaborative Partnership to Improve Environmental Performance in the Healthcare Sector

The overall goal of this project is to institutionalize regulatory compliance and pollution prevention practices in the healthcare sector. To achieve this goal, the objective of the project is to establish a formal lasting partnership with multiple healthcare and regulatory organizations and JCAHO to maximize EPA compliance assistance and pollution prevention resources, improve the environmental performance of the healthcare sector, and create incentives for continuous improvement. The final product will be a set of matrices for JCAHO surveyors and hospital personnel that align environmental regulations and environmental improvement with the JCAHO standards. The matrices will be available electronically on EPA's forthcoming Healthcare Environmental Resource Center's web site at *www.HERCenter.org*. For more detailed information on the JCAHO project, visit H2E's web site at: *www.h2e-online.org*.

National Strategies for Healthcare Providers: Pesticide Initiative

The Pesticide Initiative is an initiative created by EPA and the National Environmental Education & Training Foundation (NEETF) in collaboration with the U.S. Departments of Health and Human Services, Agriculture, and Labor. It is aimed at incorporating pesticide information into the education and practice of healthcare providers. The goal is to

improve the recognition, diagnosis, management, and prevention of adverse health effects from pesticide exposures. This initiative also serves as a model for broader efforts to educate healthcare providers about the spectrum of environmental health issues. Seven federal agencies and 16 professional associations of healthcare providers were involved in launching this initiative. For additional information, visit the EPA Pesticide Initiative web site at *http://www.epa.gov/oppfead1/safety/healthcare/healthcare.htm*

EPA and Veterans Health Administration (VHA) Cooperative Environmental Partnership

Stemming from EPA inspections of VA medical centers in 2002 that revealed repeated violations of environmental regulations, particularly those involving federal hazardous waste management regulations, EPA and VHA are conducting environmental management reviews (EMRs) at select VA medical centers. EMRs evaluate the current status of the management system and identify steps to establish a comprehensive management system for environmental compliance as well as continual improvement beyond compliance. The partnership has fostered environmental training through both EPA Headquarters and the Regions, and assisted in the development of the VA's Green Environmental Management Systems (GEMS). These efforts and others are underway to improve environmental compliance and performance at VA medical centers. For additional information visit *http://www.epa.gov/compliance/assistance/sectors/federal/epavha.html*.

The Green Suppliers Network (GSN)

The Green Suppliers Network (GSN) is a collaborative venture between industry, EPA, and 360vu, the national accounts organization of the Department of Commerce's National Institute of Standards and Technology Manufacturing Extension Partnership (NIST MEP). GSN provides expert technical assistance to small and medium-sized suppliers, through 360vu's national network of technical assistance centers. This assistance provided in a GSN Review enables suppliers to optimize processes and products, eliminate waste, reduce their environmental impacts, identify cost-saving opportunities, and remain competitive. GSN engages both original equipment manufacturers and their suppliers to achieve environmental and economic benefits throughout the supply chain. GSN has launched a pharmaceutical/healthcare initiative piloted in Puerto Rico. For additional information on the program, contact Kristin Pierre at *pierre.kristin@epa.gov* or (202) 564-8837.

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of February 17, 2004, WasteWise has 1,377 partners (including alumni) spanning more than 54 industry sectors. Members agree to identify and implement actions to reduce their

solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. Sixty-one medical services companies are partners. For more information, contact the Hotline at (800) EPA-WISE (372-9473) or the web site at *www.epa.gov/wastewise*.

Energy Star®

In 1991, EPA introduced Green Lights®, a program designed for businesses and organizations to proactively combat pollution by installing energy efficient lighting technologies in their commercial and industrial buildings. In April 1995, Green Lights® expanded into Energy Star® Buildings — a strategy that optimizes whole-building energy-efficiency opportunities. The energy needed to run commercial and industrial buildings in the United States produces 19 percent of U.S. carbon dioxide emissions, 12 percent of nitrogen oxides, and 25 percent of sulfur dioxide, at a cost of $110 billion a year. If implemented in every U.S. commercial and industrial building, the Energy Star® Buildings upgrade approach could prevent up to 35 percent of the emissions associated with these buildings and cut the nation's energy bill by up to $25 billion annually.

The more than 7,000 participants include corporations, small businesses, universities, healthcare facilities, nonprofit organizations, school districts, and federal and local governments. Energy Star® has successfully delivered energy and cost savings across the country, saving businesses, organizations, and consumers more than $7 billion a year. Over the past decade, Energy Star® has been a driving force behind the more widespread use of such technological innovations as LED traffic lights, efficient fluorescent lighting, power management systems for office equipment, and low standby energy use. For more information, contact the Energy Star Hotline, (888) STAR-YES ((888) 782-7937) or the web site at *http://www.energystar.gov/healthcare*.

Small Business Compliance Policy

The Small Business Compliance Policy promotes environmental compliance among small businesses (those with 100 or fewer employees) by providing incentives to discover and correct environmental problems. EPA will eliminate or significantly reduce penalties for small businesses that voluntarily discover violations of environmental law and promptly disclose and correct them. A wide range of resources are available to help small businesses learn about environmental compliance and take advantage of the Small Business Compliance Policy. These resources include training, checklists, compliance guides, mentoring programs, and other activities. Businesses can find more information through links on the web site at *http://www.epa.gov/smallbusiness/*.

Healthy Building Network (HBN)

Healthcare institutions are increasingly embracing green building goals driven by several important factors: public health, market competitiveness, operation costs, and social responsibility. HBN is a national network of green building professionals, environmental and health activists, socially responsible investment advocates, and others who are interested in promoting healthier building materials as a means of improving public health and preserving the global environment. For more information, contact HBN at (202) 898-1610 or the web site at *http://www.healthybuilding.net/healthcare/index.html*.

Health Care Without Harm (HCWH)

HCWH is an international coalition of hospitals and healthcare systems, medical professionals, community groups, health-affected constituencies, labor unions, environmental and environmental health organizations, and religious groups.

In 1994, EPA's draft Dioxin Reassessment identified medical waste incineration as the single largest source of dioxin air pollution. The HCWH campaign was formed in 1996 to respond to this serious problem. Since then, the campaign has grown from an initial 28 founding organizations into a broad-based international coalition. The mission of HCWH is to transform the healthcare industry worldwide, without compromising patient safety or care, so that it is ecologically sustainable and no longer a source of harm to public health and the environment. For more information, contact the HCWH web site at *http://www.noharm.org/*.

The Sustainable Hospitals Project (SHP)

SHP's mission is to provide technical support to the healthcare industry for selecting products and work practices that reduce occupational and environmental hazards. The SHP is based at the University of Massachusetts Lowell Center for Sustainable Production (LCSP). The project includes in-hospital research on implementing new products and practices, using SHP's Pollution Prevention and Occupational Safety and Health (P2OSH) model. Additionally the SHP web site, *http://www.sustainablehospitals.org*, provides a list of alternative products to help hospitals identify and evaluate more benign alternatives to existing products. SHP also provides technical support by email (*shp@uml.edu*) or phone ((978) 934-3386). For more information, contact the web site at *http://www.sustainablehospitals.org*.

Nightingale Institute for Health and the Environment (NIHE)

NIHE assists healthcare professionals recognize the inextricable link between human and environmental health and their role in changing practices to improve the health of humans and the environment. There are three initiatives associated with this program: the Trustees Initiative, the Clinicians Initiative, and the Environmental Procurement Initiative. Each initiative is designed to educate the target audience on the environmental impact of the

healthcare industry, and to offer resources that enable them to improve the environmental performance of their organizations or processes and minimize the adverse ecological impact in the communities they serve. Inherent in this project is an emphasis on sustainability, resource conservation, and life cycle thinking. For more information, contact the web site at *http://www.nihe.org/*.

Canadian Centre for Pollution Prevention (Healthcare EnviroNet)

Healthcare EnviroNet provides the healthcare community with access to environmental information, products, and services that support a commitment to quality healthcare, protection of the environment, and sustainability. Healthcare EnviroNet delivers a unique collection of Canadian-based information including:

- Green alternatives for healthcare facilities;
- Regulatory updates and government initiatives; and
- Canadian case studies.

Healthcare EnviroNet was established with funding from Environment Canada and is developed and maintained by the Canadian Centre for Pollution Prevention in consultation and partnership with healthcare and nongovernment organizations. For more information, go to the web site at *http://www.c2p2online.com/main.php3?section=83&doc_id=169*.

Recovered Medical Equipment for the Developing World (REMEDY)

Founded in 1991 at Yale University School of Medicine, REMEDY is a group of healthcare professionals and others promoting the nationwide practice of recovery of open-but-unused surgical supplies with the goal of providing international medical relief while reducing solid medical waste from U.S. hospitals. For more information, go to the web site at *http://www.remedyinc.org/about_us.cfm*.

Public Entity Environmental Resource (PEER) Center

The PEER Center is the Public Entity Environmental Management System Resource Center. A virtual clearinghouse, it is specifically designed to aid local, county, and state governments that are considering implementing or have implemented an environmental management system (EMS) and want to access the knowledge and field experience of other public entities that have done so. For more information, go to the web site at *http://www.peercenter.net/*.

ISO 14000

ISO 14000 is a series of internationally accepted standards for environmental management. The series includes standards for EMS, guidelines on conducting EMS audits, standards for auditor qualifications, and standards and guidance for conducting product lifecycle analysis. Standards for auditing and EMS were adopted in September 1996, while other elements of the ISO 14000 series are currently in draft form. While regulations and levels of environmental control vary from country to country, ISO 14000 attempts to provide a common standard for environmental management. The governing body for ISO 14000 is the International Organization for Standardization (ISO), a worldwide federation of over 110 country members based in Geneva, Switzerland. The American National Standards Institute (ANSI) is the United States representative to ISO. Information on ISO is available at the following Internet site: *http://www.iso.ch/iso/en/ISOOnline.openerpage*.

VIII.B. Summary of Trade Organizations and Industry Organizations

There are dozens of trade organizations associated with the healthcare industry. The following list is meant to act as a representative sample, not a comprehensive list.

Joint Commission on Accreditation of Healthcare Organizations (JCAHO)

JCAHO is an independent nonprofit organization whose mission is to improve the safety and quality of care through its accreditation process. JCAHO standards promote patient safety and care and good operational practices in all aspects of healthcare organizations. Nearly 17,000 healthcare organizations worldwide are accredited by JCAHO. Extensive on-site reviews are conducted at least once every three years. The reviews currently only cover environmental issues in a limited manner. See Collaborative Partnership to Improve Environmental Performance in the Healthcare Sector in Section VIII.A of this Notebook to see how H2E is working with JCAHO to help healthcare facilities improve their environmental performance. Contact Information: One Renaissance Blvd, Oakbrook Terrace, IL 60181, Phone: (630) 792-5000, Fax: (630) 792-5005, web site: *http://www.jcaho.org/*.

American Hospital Association (AHA)

The AHA provides education for healthcare leaders and is a source of information on healthcare issues and trends. Through its representation and advocacy activities, AHA ensures that members' perspectives and needs are heard and addressed in national health policy development, legislative and regulatory debates, and judicial matters. AHA advocacy efforts include the legislative and executive branches and the legislative and regulatory arenas. Contact Information: One North Franklin, Chicago, IL 60606-3421, Phone: (312) 422-3000, web site: *http://www.aha.org/*.

American Medical Association (AMA)

The AMA serves as the steward of medicine and leader of the medical profession. The AMA is the national professional organization for all physicians and the leading advocate for physicians and their patients. The AMA's envisioned future is to be an essential part of the professional life of every physician and an essential force for progress in improving the nation's health. Contact Information: 515 N. State Street, Chicago, IL 60610, Phone: (800) 621-8335, web site: *http://www.ama-assn.org/*.

American Dental Association (ADA)

The ADA is the professional association of dentists committed to the public's oral health, ethics, science and professional advancement and leading a unified profession through initiatives in advocacy, education, research and the development of standards. Contact Information: 211 East Chicago Ave., Chicago, IL 60611-2678, Phone: (312) 440-2500, web site: *http://www.ada.org/*.

American Nurses Association (ANA)

ANA focuses its work on core issues of vital concern to the nation's registered nurses - nursing shortage, appropriate staffing, health and safety, workplace rights, and patient safety/advocacy - in addition to its cornerstone work, ethics and standards.

The ANA, composed of professional nurses dedicated to the promotion of health and the care of the sick, has served as the forum in which the nation's critical health issues have been discussed throughout the last century.

Functioning as a democracy, the ANA provided the structure in which views were expressed, ideas were debated and evaluated, and positions and goals were formulated. Because it represented the views of administrators, clinical practitioners in institutions and community agencies, educators, and researchers, it has served for 100 years as the public voice for the diversity of America's professional nurses. Contact Information: 600 Maryland Ave. SW., Suite 100W, Washington D.C. 20024, Phone: (202) 651-7000, Fax: (202) 651-7001, web site: *http://www.ana.org/*.

American Veterinary Medical Association (AVMA)

The AVMA, established in 1863, is a not-for-profit association representing more than 69,000 veterinarians working in private and corporate practice, government, industry, academia, and uniformed services. Structured to work for its members, the AVMA acts as a collective voice for its membership and for the profession.

The AVMA provides a number of tangible benefits to its members, including information resources, continuing education opportunities, quality publications, and discounts on personal and professional products, programs and services. Contact Information: 1931 North Meacham Road - Suite 100, Schaumburg, IL 60173, Phone: (847) 925-8070, Fax: (847) 925-1329, web site: *http://www.avma.org/*.

American Health Care Association (AHCA)

The AHCA is a nonprofit federation of affiliated state health organizations, together representing nearly 12,000 nonprofit and for-profit assisted living, nursing facility, developmentally disabled, and subacute care providers that care for more than 1.5 million elderly and disabled individuals nationally.

AHCA represents the long-term care community to the nation at large – to government, business leaders, and the general public. It also serves as a force for change within the long-term care field, providing information, education, and administrative tools that enhance quality at every level.

At its Washington, D.C. headquarters, the association maintains legislative, regulatory and public affairs, as well as member services staffs that work both internally and externally to assist the interests of government and the general public, as well as member providers. In that respect, AHCA represents its membership to all publics, and national leadership to its members. Contact Information: 1201 L Street, N.W., Washington, D.C. 20005, Phone: (202) 842-4444, Fax: (202) 842-3860, web site: *http://www.ahca.org/*.

American Society for Healthcare Environmental Services (ASHES)

Setting the standard for environmental excellence, ASHES advances healthcare environmental services, textile care professions and related disciplines. ASHES leads, represents and serves our members by promoting excellence, best practices, innovation, and leadership through advocacy, education and certification. Web site: *http://www.ashes.org/*.

American Society for Healthcare Engineers (ASHE)

ASHE is the advocate and resource for continuous improvement in the healthcare engineering and facilities management professions. Web site: *http://www.ashe.org/*.

College of American Pathologists (CAP)

The CAP, the principal organization of board-certified pathologists, serves and represents the interest of patients, pathologists, and the public by fostering excellence in the practice of pathology and laboratory medicine.

The CAP's Strategic Plan is intended to help ensure that the College fulfills its mission in a thoughtful and effective manner. The plan contains 13 specific directions that the College will follow in carrying out its commitment to members, their patients, and the public. CAP members can download a copy of the Strategic Plan; log in to access the file. Contact Information: 325 Waukegan Road, Northfield, IL 60093-2750, Phone: (847) 832-7000, Fax: (847) 832-8000, web site: *http://www.cap.org/*.

National Indian Health Board (NIHB)

The NIHB represents Tribal Governments operating their own healthcare delivery systems through contracting and compacting, as well as those receiving healthcare directly from the Indian Health Service (IHS). Contact Information: 101 Constitution Ave. N.W., Suite 8-B02, Washington, D.C. 20001, Phone: (202) 742-4262, Fax: (202) 742-4285, web site: *www.nihb.org*.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS/ BIBLIOGRAPHY

For further information on selected topics within the healthcare industry, a list of publications and contacts is provided below:

IX.A. Contacts/Document Reviewers[11]

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Anuj K. Goel, Esq.	Director, Regulatory Compliance, Massachusetts Hospital Association	(781) 272-8000, ext. 140 / *agoel@mhalink.org*	Characterization of the Healthcare Industry
Charlotte A. Smith, R. Ph., M.S., HEM	President, PharmEcology Associates, LLC	(262) 814-2635 / *info@pharmecology.com*	Activity Descriptions
Laura Brannen	Hospitals for a Healthy Environment	(603) 643-6700 / *laura.brannen@h2e-online.org*	Hospital Wastes
Jeffrey Keohane	Karshmer & Associates (P.C.)	(510) 841-5056 / *keohane@karshmerindianlaw.com*	Environmental Regulations on Indian Country
Eydie Pines	Hospitals for a Healthy Environment	(603) 643-6710 / *eydie.pines@h2e-online.org*	Pharmaceutical Waste
Fawzi M. Awad, M.S., E.H.S. II	Saint Paul-Ramsey County Department of Public Health, Environmental Health Section	(651) 773-4459 / *fawzi.awad@co.ramsey.mn.us*	Minnesota Pollution Control Agency Fact Sheets
Catherine Galligan	Sustainable Hospitals Project Clearinghouse Manager	(978) 934-3386 / *shp@uml.edu*	Healthcare Wastes and Sustainable Hospitals Project Fact Sheets
Kathleen Malone	EPA, Region 2	(212) 637-4083 / *malone.kathleen@epa.gov*	Federal Statutes and Regulations

[11] Many of the contacts listed in this section have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this Notebook.

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Cathy Knox	Director, EHS Parker Hughes Cancer Clinic (PHCC)	*cknox@ih.org*	Healthcare Wastes
Chen Wen	EPA, Office of Pollution Prevention and Toxics	(202) 564-8849 / *wen.chen@epa.gov*	H2E
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Kristina Meson	EPA, Office of Solid Waste	(703) 308-8488 / *meson.kristina@epa.gov*	Hazardous Waste

IX.B. Bibliography

Below is a list of references used in compiling this Sector Notebook, by section. The Healthcare Environmental Resource Center contains additional details on most of the subjects touched on in this Notebook and is an excellent follow-up reference for locating information on state and local requirements. For your convenience, the Center maintains current URLs for all of the sites mentioned in this document at *www.HERCenter.org*.

Section II - Introduction to the Healthcare Industry

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Minnesota Pollution Control Agency Health Care Fact Sheets: These are available online at *http://www.pca.state.mn.us/industry/healthcare.html*. Over three dozen short, informative summaries covering all aspects of the healthcare industry.

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Office of Enforcement and Compliance Assurance
1200 Pennsylvania Avenue, NW (MC 2224-A)
Washington, D.C. 20460

EPA/310-R-05-002
February 2005

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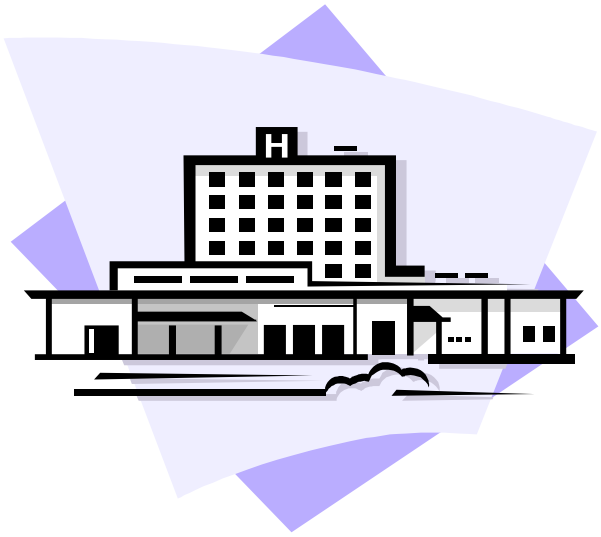

Kentucky Pollution Prevention Center

September 2002

Acknowledgements

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Kitchener, ON Canada	Prevention Center	Prevention Center

Considerable effort has been taken to ensure the accuracy of information in this manual. Regulatory requirements can vary based on locale. Please verify your requirements with applicable federal, state, and local authorities.

September, 2002

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Section 4: General Pollution Prevention (cont.)

Section 5: Planning and Managing the EMS

Section 6: Continual Improvement

Section 7: Resources

Introduction

"Health care has an ethical duty to do no harm to human health. The reality is that, as a significant economic sector, its operations inadvertently cause harm to the environment and thus to human health. In short, health care has a significant ecological footprint, which has important implications for the health of this and future generations." Source: Green Hospitals: Success Stories of Environmentally-Responsible Health Care", The Canadian Coalition for Green Health Care, October, 2001 pg. 1

"It is incompatible with the mission of the institutions devoted to healing to be significant consumers of resources and sources of environmental harm through air and wastewater emissions, hazardous and solid waste generation, greenhouse gas emissions, and toxic chemical usage." Source: Canadian Centre for Pollution Prevention, 2001

Medical waste incineration, persistent bio-accumulative toxins (PBT) such as mercury, and hazardous material use and waste disposal have all heightened public and political scrutiny of the healthcare industry's impacts on the environment as well as on the health of hospital visitors, patients, staff and the surrounding community. Given healthcare's mission to promote health and wellness, hospitals need to continue proactively managing activities, products, and services to minimize these significant impacts.

While many organizations, including hospitals, strive to take on voluntary environmental initiatives such as pollution prevention, these efforts often fail to take root over extended periods of time due to the lack of an organizational, systematic environmental management framework. This can result in an environmental compliance focus only, missed cost savings that can help the bottom line, and the missed opportunity to boost morale by involving employees in something they generally feel good about—helping the environment. These are opportunities few hospitals can afford to miss in the industries' rigorous, if not exacting, competitive climate.

Environmental management systems (EMS) represent a new way of doing business. The EMS approach takes proven business principles and applies them to environmental performance. EMSs promote continual improvement by challenging your hospital to identify all of its environmental impacts, determine which are most important, and set performance-based objectives and targets to minimize these impacts on an ongoing basis. This prioritization is a tremendous benefit.

There are many additional EMS benefits. Foremost among these is improved hospital reputation and image. EMSs open up environmental communication between the hospital and key stakeholders including employees and the community. An EMS will challenge you to seek community input when determining which environmental impacts to address first. This communication puts you on the road to improved community relations, enhanced reputation and image, and ultimately to healthier patients, visitors, staff, and neighbors.

This manual was prepared to provide Kentucky hospitals with guidelines for the reduction of PBTs and pollution prevention through an EMS approach. Our intent is to provide you with this information in a clear, concise fashion consistent with the needs of the healthcare industry.

What are Environmental Management Systems?
What Do They Mean for Healthcare?

What is an Environmental Management System (EMS)?

EMSs are business systems that allow you to manage your hospital's environmental issues in a systematic, organized fashion based on continual improvement-just like any other business area such as quality, accounting and payroll, inventory management, and cash flow. Like these other areas, EMSs focus on top management support and commitment, accountability/responsibility, employee involvement and training, documentation, operational controls, and periodic checking and review with corrective action. You likely have environmental policies, procedures, pollution prevention (P2) initiatives, and regulatory tracking and compliance efforts already in place. An EMS simply formalizes, builds on, and consolidates these into a more easily managed system that can result in a number of benefits for you and your company.

EMS Component Descriptions

ENVIRONMENTAL POLICY		A statement of a facility's environmental intentions.	Similar to a hospital's mission statement, health and safety policy, etc.
PLANNING	Environmental Aspects and Impacts	An analysis of the hospital's activities, products, services to identify those that may have a "significant" impact on the environment.	Examples: use, handling and proper disposal of radioactive materials, use of significant amounts of energy and water in facilities management, etc.
	Legal and Other Requirements	Providing a method for identifying, applying and updating all environmental compliance requirements.	Also include voluntary or industry specific codes, (Accreditation Standards), memorandums of understanding, codes of practice, etc.
	Environmental Objectives and Targets	Setting achievable goals based on the hospital's "significant" aspects or issues, legal requirements, financial capabilities, etc.	Can be hospital-wide (ex- reducing energy use) or department-specific (ex. implementing an organics-recycling program in Food Services.)
	Environmental Management Programs	Developing specific actions, designating resources and timelines for the completion of your environmental objectives and targets.	Use as a way to determine budgetary requirements for implementation of an objective.
IMPLEMENTATION & OPERATION	Structure and Responsibility	Determine responsibilities under the EMS (ensuring that adequate resources are allocated).	Include the roles of Senior Management, management, front-line staff, patients, contractors, etc.
	Training, Awareness and Competence	Ensure that hospital staff receives training (relating to their environmental responsibilities).	Some training may require general awareness (ex. overall knowledge of environmental policy) and others may require competence (ex. spill training).
	Communication	Establish methods for relaying and documenting environmental communications with staff, patients, visitors, contractors, etc.	Use existing modes of internal communications when possible (i.e. hospital newsletters, emails, displays, posters, staff meetings, etc.)
	EMS Documentation	Maintain all EMS related documentation to ensure that they are available, up-to-date, and obsolete documents are promptly removed.	Think about computerizing your EMS manual (if you have a hospital-wide system that is available to all staff). Updating and editing a computerized system requires much less time than using a number of paper manuals).
	Document Control	Ensure that all documentation (policies, procedures, etc.) are controlled, dated, approved, and reviewed.	Utilize existing hospital formats/templates of procedure/policy documentation.
	Operational Control	Review operating procedures relate to positions/processes so that significant environmental impacts are addressed. Train staff on the importance of conforming to the procedures.	Example: ensure all staff handling chemicals (especially Laboratory, Diagnostic, Housekeeping, and Maintenance staff) are aware of, and utilize proper chemical handling, transport and disposal procedures.
	Emergency Preparedness and Response	Establish procedures for addressing environmental disasters and accidental releases to air, land and water.	Hospitals commonly use universal "Emergency Codes" (i.e. Code Red- Fire, Code Brown- Chemical Spills, etc.)
CHECKING & CORRECTIVE ACTION	Monitoring and Measurement	Track key components of your environmental performance.	Track the progress of your objectives, occurrence of regulatory inspections, calibration records, etc.)
	Nonconformance and Corrective and Preventative Action	Provide a means for documenting environmental issues/hazards. Identify corrective and/or preventative actions to prevent reoccurrence.	Tap into existing means for reporting hazards and incidents (i.e. Employee Incident Reporting Forms, departmental inspections, etc.)
	Records	Maintain records that relate to environmental performance, compliance, inspections, etc.	Keep in a centralized location (if possible the EMS Administrator's office/work area)
	EMS Audits	Perform periodic audits to ensure that all components of your EMS are working properly.	Example: Form an EMS Audit team of a few keen staff members.
MANAGEMENT REVIEW		Provide EMS-related information to senior management for periodic review and/or approval to ensure continual improvement of your system.	Tap into existing reporting structures (i.e. monthly reports, annual reviews, management meetings, etc.)

You will see the term ISO 14001 throughout this manual. ISO 14001 is the international benchmark against which most EMSs are compared for registration purposes. Registration means that independent third party auditors come to your hospital and assess your system against the standard for completeness. You can achieve many of the same benefits of having an EMS whether or not you pursue registration. This manual follows the ISO 14001 standard as the template for implementing an EMS.

EMSs and healthcare is a very new concept. Currently, only two hospitals in North America are ISO 14001 registered: Cambridge Memorial Hospital, and St. Mary's General Hospital in Ontario, Canada.

CAMBRIDGE MEMORIAL HOSPITAL
700 Coronation Blvd.
Cambridge, ON N1R 3G2

1.0 Background Information

Cambridge Memorial Hospital is a 277-bed facility providing the 120,000 residents of Cambridge and North Dumfries with acute, ambulatory, and long-term care services. This health care facility was the first hospital in North America to implement an EMS and obtain ISO 14001 registration.

2.0 Why did CMH implement an EMS?

During recent years, the Board of Directors established a new vision, moving from a model of "curing the sick" to one focused on improving the health of the community and the local environment. Implementing an EMS was seen as a milestone in achieving this vision.

3.0 How did CMH implement its EMS

In June 1998, CMH's Board of Directors approved an environmental policy for the hospital, marking the beginning of EMS implementation. Work on the EMS implementation continued through year 2000.

4.0 What has Cambridge achieved through the EMS?

Cambridge Memorial achieved a 20% reduction in biomedical waste in each of the first two years of EMS operation. Cambridge implemented an integrated pest management program, eliminating the use of chemical pesticides and herbicides, and added criteria for energy conservation to consider in selecting new products and equipment. As part of its chemical substitution program, Cambridge Memorial Hospital has initiated a mercury-free medicine campaign to phase out mercury-containing products and eliminate the release of mercury to the environment. Just prior to EMS inception in May 1998, the hospital shut down the 25-year old incinerator, eliminating its contribution to local air pollution and reducing greenhouse gas and energy consumption. Staff training and community awareness has been key to meeting the hospital's environmental goals. CMH actively pursues green team initiatives to promote environmentally friendlier and healthier alternatives to transportation such as car-pooling, public transportation, biking, walking, etc. Sustainable building design is a key element used in planning a new 115,000 square foot addition to the hospital, which has participated in the Commercial Building Incentive Program (CBIP) and C-2000 Advanced Commercial Building Program through the Office of Energy Efficiency in Natural Resources Canada. CBIP buildings must use less than half the energy of conventionally designed buildings.

Highlights:

Initiated a Mercury Free Medicine Campaign

The Cambridge GREEN Team made a formal pledge to develop a comprehensive program to eliminate the release of mercury to the environment. A mercury audit was completed to identify all mercury sources. Twenty-one staff, encompassing hospital 3 areas, received education in-service sessions to alert the staff about mercury spills response procedures as well as the environmental and health consequences of the use of mercury. Measures continue to be implemented to phase out mercury-containing products such as blood pressure measuring devices. A final SWEEP throughout CMH was completed to verify that all Hg blood pressure cuffs and thermometers have been properly removed and replaced.

Pollution Prevention Pledge Project

CMH pledged a 30% reduction in biomedical waste as part of the Ministry of the Environment P2 Pledge Program (P4). The P4 program is a voluntary initiative that

encourages companies and organizations to commit to reducing pollutant releases, hazardous or liquid industrial waste or toxic chemicals. Cambridge's reduction in biomedical waste in 1999 earned the P^3 Reduction Achievement Award. CMH continued its track record with a 20% reduction in 2000.

4.0 Lessons Learned

Creating a green team helps implement initiatives faster. Staff training and persistence are key to success.

5.0 Contact:

Mary Jane Hanley,
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Cambridge Memorial Hospital
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Fax: 519-740-4928
Email: mhanley@cmh.org

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911 Queens Boulevard.
Kitchener, ON, Canada
N2M 1B2

1.0 Background Information

St. Mary's General Hospital is a 168-bed facility serving nearly 500,000 people in southern Ontario. St. Mary's was recently designated the region's Cardiac Care Center.

The hospital began developing its EMS under a university-planned venture between St. Mary's, Cambridge Memorial Hospital, Cambridge, Ontario and the University of Waterloo, Waterloo Ontario. In October 2001, St. Mary's became ISO 14001-registered, the second North American hospital to achieve this distinction. As a result of the hospital's EMS, St. Mary's has been the honored recipient of a number of provincial and regional awards.

2.0 Why did St. Mary's implement an EMS?

Board of Trustee environmental concerns about chemical usage spearheaded an initial investigation of how the hospital managed its environmental affairs. Investigation results lead to additional Board and Senior Management-level discussions concerning other environmental issues and identified the need for the hospital to proactively address its internal and external environment.

3.0 How did St. Mary's implement its EMS?

After reviewing recommendations outlined in reports from a local university environmental class, the hospital's Director of Facilities Services brought the idea of an EMS to the Senior Management Team and Board of Trustees. The Board hired a recent

graduate to implement the EMS. Through this joint-hospital effort with Cambridge Memorial, St. Mary's planned, developed and implemented its EMS using the ISO 14001 standard as a guide.

St. Mary's is committed to promoting "Health care for a Healthy Environment" and through continual environmental education, promotion and awareness, all levels of hospital staff and volunteers become aware and participate in the hospital's environmental pledge.

4.0 What has St. Mary's achieved through its EMS?

The principle EMS accomplishments to date include the following.

Waste Management

Improved biomedical waste segregation and establishment of comprehensive recycling programs are two key achievements. Since 1998, St. Mary's has reduced biomedical waste by 38% (by weight) implemented programs to recycle the following.

- Glass, cans (aluminum & steel), plastic, newspaper, cardboard, boxboard, paper (all grades), alkaline and nickel-cadmium batteries, all-types of metal, photocopier cartridges, cold packs, Styrofoam boxes.
- Fluorescent tubes. St. Mary's recycled the mercury, glass, aluminum, and phosphor powder in over 2000 florescent tubes.
- Cardboard through a take-back program with its suppliers.
- Unused patient and cafeteria food through a local organics composting company.
- Biomedical waste containers through newly selected medical waste hauler.

Energy Conservation

St. Mary's "energy plan" addresses new construction and renovation projects; equipment (lighting, powerhouse equipment, etc.); and internal energy education/ communication of hospital staff. The hospital formed a multi-disciplinary team of energy conservation consultant, architects, mechanical and electrical engineers to design an energy-friendly addition to house its new Cardiac Care Center. Design

plans will allow St Mary's to reduce energy usage 30% compared to conventionally designed buildings.

In addition, St. Mary's:

- Purchased a hydro usage software program to identify and target energy usage patterns;
- Performed a steam trap survey and implemented resulting recommendations;
- Replaced all T12 fixtures with more energy-efficient T8s;
- Developed an energy education program with a mascot that provides energy tips and reminders;
- Formed an "Energy Team" to standardize purchases of energy-conserving office equipment and small appliances;
- Plans to upgrade to more energy-efficient windows.

Landscape Management

In 2000, St. Mary's was among the first hospitals in Ontario to eliminate chemical pesticide and herbicide usage on hospital grounds. By working with the hospital's current landscaping company and landscaping professionals, St. Mary's has maintained a healthy, chemical free landscape. St. Mary's no longer mows on smog-alert days. Newly designed landscape plans will incorporate, where possible, drought resistant/salt tolerant/native plants, ground covers, and other environmentally conscious options.

Alternative Transportation

To promote green transportation St. Mary's has:

- Circulated an "Employee Alternative Transportation Survey" for staff to evaluate transportation habits and identify future initiatives that the hospital staff would like to see;
- Purchased additional bike racks;
- Implemented a "Share-a-Ride" program on the hospital's internal email system that allows staff wishing to carpool to find another individual in their area;

This goal is ongoing and future plans have been developed to provide staff with discounted bus passes, safe biking lessons, and improved showering facilities.

Chemical Recycling & Wastewater Discharges

St. Mary's is a member of the Health Care Without Harm's Mercury Medicine campaign. To date, the hospital has eliminated all mercury containing devices in patient care areas. The hospital is working to identify alternatives for pressure and floating switches in powerhouse equipment and to find a replacement for the mercury thermometer standard for calibrating medical equipment.

Through a regional business water quality program, St. Mary's has identified and re-mediated many water-polluting processes. In particular, St. Mary's installed xylene and formalin recycling equipment and eliminated related discharges.

5.0 Lessons Learned

Senior Management Approval and Support

Senior Management support and buy-in is critical and needs communicated to all staff prior to starting the process. A letter of support circulated throughout the hospital is one way to communicate this support.

Staff Involvement

Everyone has responsibilities under the EMS- not just the EMS Representative. Ensure that you ask staff (front line, nursing, physicians and management) to participate in the EMS wherever and whenever possible (i.e. Green Team, hospital auditing team, implementing objectives and targets, fun initiatives, etc.).

Integration of Documentation

Designing an EMS involves the development of policies, procedures and work instructions by the EMS Representative and Department Managers/Supervisors. Ensure you integrate all document formats with the hospital's existing systems.

Recognize the Efforts of Individuals and Departments

To maintain momentum, formally recognize individuals and departments that demonstrate enthusiasm, participation and involvement in the EMS.

Be Creative

Come up with fun ideas and initiatives to get your staff involved. Use existing national holidays such as Earth Day to organize fun events.

6.0 Contact:

Shannon-Melissa Dunlop
Environment, Health and Safety Specialist
St. Mary's General Hospital
Tel: (519) 749-6406
Fax: (519) 749-6426
Email: sdunlop@stmaryshosp.on.ca

Benefits of an EMS

Cost Savings through EMS Implementation

Hospitals have a wide variety of activities, products, and services including emergency care facilities, laboratories, diagnostic clinics, offices, operating suites, pharmacies, warehouses, sterilization services, restaurants, and massive power plants. These areas use tremendous resources and can generate biomedical, hazardous and solid waste. All have opportunities that can help your bottom line and free money for new projects. In general, it is difficult to estimate how much money an EMS can save you, but having an EMS systemizes the search for, review, and implementation of cost saving opportunities through the setting of P2-oriented objectives and targets. There are a number of hospital-specific EMS objectives that can provide this outcome.

1. Energy conservation. A well-designed and researched energy conservation strategy can provide significant immediate, short and long-term cost saving benefits. Saint Joseph's Medical Center in Yonkers, New York achieved savings of "more than $250,000 a year" through energy conservation efforts. (*Source: Dunn, Philip, Hospitals and Health Network).* When planning an energy program, look at a performance based contracts. Contractors earn a percentage of their total costs back if they meet a minimum overall energy savings level for your hospital.

2. Solid Waste Reduction. You may find that 70-80% of your biomedical waste stream is actually daily waste such as paper towels, disposable packaging, and coffee cups. You can reduce red bag fees by keeping these wastes separate.

3. Environmentally Preferable Purchasing, or EPP. Hospitals are relatively new to the "green" products market but are large consumers of good and services. For example, purchasing mercury-free products helps the environment by not putting toxic chemicals into the supply chain. Contact your supplier(s) and ask to be a hospital "test site" for environmentally preferred products. If your management agrees, a company can use your product trial data to approach other health care facilities and earn more business. In turn, your hospital may

be able to negotiate a decreased cost for buying the product. This can be a valuable hospital strategy, particularly if you are in search for environmentally friendly substitutes.

By investigating environmental opportunities for your hospital you may come across environmental funding prospects through local business, local government or state funded programs. Look to local P2 centers and state authorities for information on any of these programs in your area (see the National Pollution Prevention Roundtable yellow pages at www.nppr.org for contacts).

Accountability

Traditionally, environmental affairs have been delegated from upper management to environmental specialists and away from the rest of a hospital's operations. When an EMS is in place, all employees, including upper management, have responsibility for overseeing and ensuring environmental performance. All are accountable for compliance with standards and requirements. Upper management is responsible for providing resources needed for the EMS and ensuring that performance, evaluation, and disciplinary procedures are in place to support the EMS performance-based objectives and targets.

Consistent, Reliable Results

What would happen if an environmental inspector showed up while you or other environmental staff were out of the office? What would happen if the environmental manager moved on to new work? Would your hospital stay environmentally focused? An EMS helps ensure consistent environmental performance even when there are key personnel changes. There are others delegated in the organization, knowledgeable on the EMS and environmental performance.

Measurement

What gets measured gets done. It's that simple. An EMS focuses on setting measurable goals and objectives and measuring performance and progress against them. Two measurable performance aspects in an EMS are regulatory compliance and P2. Focusing on these, for example, helps you avoid unnecessary paperwork and costs

associated with excess raw material use and waste generation. These help another measurable item-your bottom line: profitability.

Due Diligence and Improved Compliance

Compliance benefits are a common question for many contemplating an EMS. While compliance is not 100% guaranteed, an EMS puts procedures in place to help you stay current on compliance issues, check performance against these requirements, and implement corrective actions if performance falls short of these requirements. This, in turn, demonstrates due diligence and reduces environmental risk and the possibility of regulatory fines.

Less Day-to-Day 'Putting Out Fires'

Enhanced compliance is just one of the additional benefits. As one Kentucky environmental manager recently stated: "The benefits of an EMS go way beyond compliance. It has helped us identify significant cost areas we previously overlooked and has helped with the day-to-day managing of our environmental efforts." In other words, less cost and fewer headaches.

Greater Staff Environmental Awareness and Commitment

At St. Mary's General Hospital in Ontario, Canada, staff within the Pharmacy department identified possible reuse opportunities for Styrofoam containers and cold packs delivered weekly to the department. Products that were once thrown in the garbage are now taken home by staff to reuse. While department specific efforts like this may have only minimal dollar savings, the savings can quickly add up when applied across the whole hospital. This is just one example of how employees become more environmentally aware. An EMS will ask employees to know the environmental impacts of the their work and how they can do their work in an environmentally-aware manner.

Continual Improvement

The overall objective of an EMS is to promote continual improvement in environmental performance and change an often prevailing culture from one of simply reacting to environmental concerns and opportunities to a more proactive, anticipatory approach. This is often summed up in the "Plan, Do, Check, Act" cycle. The focus of an

effective EMS is not simply developing, reviewing, and improving processes and procedures, but more importantly, improving actual environmental performance and results. The processes and procedure are a means to an end, not the end itself. Refer to the Standard EMS Implementation Cycle Diagram below for an overall understanding of the process that helps ensure the EMS stays results-oriented.

Standard EMS Implementation Cycle

1. Environmental Policy

A statement of the facilities environmental intentions.

2. Planning

Identifying compliance requirements, and the significant environmental issues associated with a facilities activities and operations. Developing documented objectives, targets and management programs to address these areas.

3. Implementation & Operation

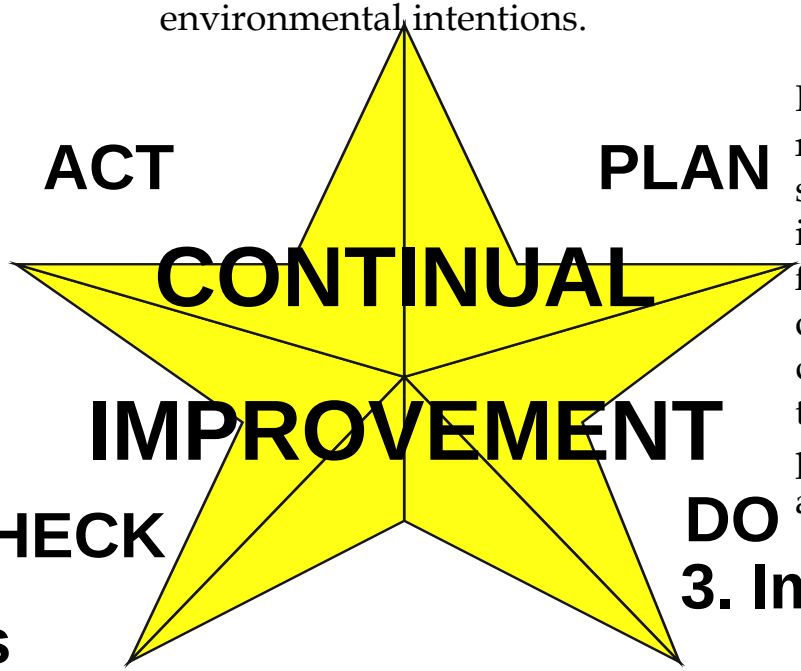
Identification of EMS responsibilities, training requirements, communication methods, documentation control, operational control & emergency response.

4. Checking & Corrective Actions

Tracking key environmental performance indicators, identifying and remediating non-conformances, maintaining records, and performing regular EMS audits.

5. Management Review

Periodically reporting overall EMS progress and other related information to your senior management for review, approval, and to ensure the continual improvement of the overall system.



Managerial Points to Ponder

One size does not fit all: EMSs are highly individualized and must mesh with your organization's culture and administrative framework to be fully effective. In particular, your environmental issues and opportunities may be different from the next hospital. Your processes and procedures may differ. When possible, we offer multiple examples so you can pick what works for your hospital and then develop the procedure that works best. We include at least one example procedure for you to look at in the immediate text; extra example procedures and documentation can be found at section's end. These procedures are examples only; please feel free to modify them to fit your hospital.

Pay attention to culture: Experience shows that the technical aspects of an EMS such as writing procedures, organizing documentation, and maintaining a list of compliance obligations are less a challenge than obtaining and maintaining top management support and initiating the cultural changes needed for the EMS to take root initially and be sustainable over the long-term. Building on how things are done and improving them when needed, respects the established culture and enhances the EMSs chance of success.

Be open to new participants in the environmental program: EMS implementation challenges many environmental managers to take a broader look at what they do on a day-to-day basis. Many environmental managers are comfortable with the compliance-based approach to environmental management: filling out and submitting regulatory paperwork, policing work areas to make sure people are doing things right, and personally handling the details of getting things done, often in isolation from the rest of the organization's priorities. A manager that continues to function with only the skills used to get these tasks done will have a difficult time implementing an EMS. EMS implementation requires sharing control and responsibility for environmental tasks, delegating tasks, and effective facilitation skills. In short, the environmental manager should not always automatically be selected as the EMS management representative. Respect from coworkers, willingness to delegate, and ability to share power/control are key attributes of a successful EMS representative.

Think effective planning and project management: Simply stated, implementing an EMS is simply completing series of smaller, manageable projects over time. The more effectively these projects are planned out in advanced and then managed, the more effectively EMS implementation occurs. Consequentially, effective planning and project management are among the most important skills to implementing an EMS cost-effectively and with the least disruption to hospital operations. These are skills to look for when you select your hospital's EMS representative.

Build on what's in place: The components of an EMS build on one another. Integrating EMS components into your existing hospital structure not only saves time in development and training, but aids in the facilitation of the overall success of the system. For example, hospitals tend to have many existing procedures for reporting incidents and addressing various types of emergencies. EMS representatives can build on these for identifying, communicating, and following up on environmental incidents.

Approach to Implementing an EMS

Some organizations implement their EMS following the order in which the ISO 14001 standard presents the components as shown in the "Plan, Do, Check, Act" diagram. For example, many organizations write the environmental policy first. The policy states an organization's environmental commitment and can serve as a first communication from top management to all employees on the importance of the EMS. There are drawbacks to following the order in the standard. Necessity often drives what sections of the ISO 14001 standard organizations implement first. Many EMS organizations appoint the EMS management representative as a first step instead of writing the policy so people have a point of contact for the EMS. This manual follows a performance-based approach to EMS implementation, attempting to cover implementation in the order most commonly observed in practice.

Getting Support and Getting Started

Overview of Hospital Corporate Structure and EMS Roles and Responsibilities

The Internal Responsibility System (IRS) is a health and safety philosophy based on the principle that every individual in the workplace is responsible for health and safety. That includes the CEO, executives, management and workers. SOURCE: Workplace Safety and Insurance Board (WSIB), Ontario, 2001

While internal management structures may vary somewhat from hospital to hospital all operate with distinct levels of senior management, middle management, and associates. All levels have a role in environmental management.

Board of Trustees

This governing body is often comprised of hospital staff and community and health care professionals. Board members are hospital "stewards" with responsibility for the overall direction and planning of the hospital. Trustees approve corporate-wide programs, make significant hospital decisions, and discuss current and future hospital initiatives. The Board's EMS responsibilities can include the following.

- Establishing the environment as a priority by approving and abiding by the environmental policy; and
- Supporting cost effective environmental initiatives that protect the hospital from legal and financial liability and promote environmental health in the community.

Senior Management

The Senior Management team comprised of the President, Chief Executive Officer, Vice-Presidents/Directors/Program Managers from various functional centers throughout the hospital, often plan present and future hospital programs/operations and ensure they remain efficient, effective and fiscally responsible. Senior Management's EMS responsibilities include the following.

- Approve the overall EMS and ensure that EMS remains suitable, adequate, and effective;

- Appoint EMS Representative(s). Define EMS Management Representative and EMS Administrative Representative positions as job functions (either one person with dual role or two separate positions) This is further discussed in the "Choosing your EMS Representatives" section of this guide;
- Establish the environment as a priority by approving and abiding by the environmental policy;
- Support cost effective environmental initiatives that protect the hospital from legal and financial liability;
- Ensure that the resources (i.e. human, physical and financial) essential to the implementation and continuation of the EMS are available;
- Conduct management review of the EMS.

Unlike many other efforts that start at the grass-roots level and work their way up, EMS implementation is a top-down process. Without Senior Management support, the EMS will very likely fail.

Middle Management

Hospital middle management includes Program/Department Managers, Supervisors, and Coordinators that oversee the day-to-day management of hospital programs including patient services, support services, and facility management. Middle Management plays a significant role in the EMS, particularly in the follow-through stages associated with staff environmental training, awareness activities, and standard operating procedures. Middle Management EMS responsibilities include the following.

- Implement, comply with, and maintain the EMS within the scope of their functional roles.
- Comply with all applicable environmental requirements, policies, and procedures;
- Attend at least EMS general awareness training; and
- Ensure employees are given the time and opportunity to attend EMS training, participate as auditees and auditors (as interested or chosen) and assist in writing effective work instructions for their respective work areas.

Hospital Employees

Excluding management, hospital employees include physicians/doctors, nurses, specialists, technologists, support staff, and all other union and non-union staff. Hospital employees' responsibilities include the following.

- Implement, comply with, and maintain the environmental management system within the scope of their functional roles;
- Comply with all applicable environmental requirements, policies, and procedures; and
- Attend EMS training, participate as auditees and auditors (as interested or chosen), and assist in writing effective work instructions for their respective work areas.

Recruiting keen front-line staff to assist with aspects identification and communication will prove to be of great value. Ask each department to designate one employee as an EMS contact or delegate. Use this person to transfer environmental information to and from the department.

Getting Support and Buy-In for an EMS

Senior Management and Board

Gaining Senior Management and Board support and then working your way down the hospital's corporate structure is key. Consider scheduling a meeting with your Senior Management Team to discuss and provide the following.

1. A description of what an EMS is and why it would benefit your hospital;
2. The environmental issues, particularly compliance-related, that the hospital currently faces (highlight environmental legal concerns and due diligence issues such as incineration, biomedical waste, hazardous waste, PVC/Mercury, spill response, etc., if these areas apply to your hospital);
3. The expected resources and time requirements for initially developing and implementing an EMS; and
4. Top management's roles and responsibilities in implementing and maintaining the EMS.

You may wish to have an EMS gap analysis completed at your hospital and present the results during this initial meeting with your Senior Management team. In some organizations, Senior Management prefers to conduct the gap analysis prior to deciding whether to implement an EMS.

SOME OF THE POSSIBLE BENEFITS OF DEVELOPING AN EMS AT YOUR HOSPITAL

1. Cost savings;
2. Better patient care;
3. Improved reputation among peers in the health care sector;
4. Improved waste segregation and waste minimization programs;
5. Heightened staff knowledge and involvement in environmental programs and issues;
6. Improved health and safety relating to environmental issues (i.e. chemical management, emergency preparedness);
7. Improved pollution prevention programs decreasing the facilities negative impact on the local environment;
8. Due diligence through improved compliance;
9. Decreased risk and liability;
10. Improved environmental record keeping and document control (especially for legal documents requiring

A gap analysis simply identifies the elements of an EMS that your facility has in place and areas of needed improvements. An example gap audit tool developed by the Kentucky Pollution Prevention Center can be found in the Resources Section of this manual. A more comprehensive gap analysis may also include sections on environmental compliance and risk. You can conduct the audit in-house or contact a representative from your local pollution prevention center that provides this service. Keep in mind, it is highly probable that your hospital has many of the required EMS components in place already, and other provisions may require only mere edits to exiting procedures. The utilization of existing hospital processes in all stages of the system is an EMS best management practice.

The decision to implement an EMS should first be presented to and approved at the Senior Management level prior to going to the Board for comments and approval. They are the first communication link to the Board of Trustees and often a source of agenda items and topics to be reviewed at monthly Board meetings. Your hospital's Senior Management team also approves and allocates funds for the hospital's upcoming operating budget.

Look to your Board members as potential environmental allies. Board members may live in the local community and have the same environmental concerns of your staff and local residents. Ask around and tap into these influential and professional resources at your hospital for support. For example, in 1998 at St. Mary's General Hospital in Ontario, Canada, a concerned Board member was one of the first hospital staff to question hospital practices (i.e. chemical usage on the hospital grounds) with the environment in mind. From this inquiry, St. Mary's investigated ways to address such environmental issues that ultimately resulted in the implementation of an ISO 14001-aligned EMS. St. Mary's is the second hospital in North America to implement an EMS.

Hospital Staff

Once you have obtained approval to go forward with EMS development, you must sell the idea to your hospital staff. This can be done through a number of communication tools. Here are a few tips.

1. Work with your Communications and Public Relations personnel to create a letter of support from your CEO/President to all hospital staff (you can use this letter to reinforce your Senior Management's commitment to the project when staff ask the question "why are we doing this?"). If you choose to write your environmental policy first, the policy can be a part of the first communication of the EMS.
2. Develop department specific training sessions on what EMS is and why the hospital is proceeding with its development (essentially you will be performing an EMS "road show" – remember, if you can, bring sweets- it'll get their attention!)
3. Develop displays, table cards, emails, and articles in your hospital's newsletter to get the word out. Focus on the environmental issues faced by the health care industry and how the EMS will encourage and support the statement's set forth in your hospital's mission statement.
4. Ask for involvement and input from your staff at all times. Include them throughout the process. You would be surprised by the great ideas and programs staff are doing in their own homes!

5. Plan an environmental fair. Include information on: local recycling programs, composting programs, hazardous waste depots, healthy landscaping ideas for your home, mercury take-back programs, local environmental not-for-profit groups, environmentally-friendly hospital products, energy conservation and efficiency, alternative transportation methods (busing, biking, carpooling to and from work), and water conservation initiatives. Give your staff a taste of the possible environmental opportunities available to the hospital.
6. Always be enthusiastic – enthusiasm is contagious and makes sessions fun!

Ideally your staff will embrace the idea of "green health care" as it goes hand-in-hand with the overall mission of the healthcare industry. However, you may get resistance due to the fact that people see the EMS as a make-work project. Initially, any new program will require additional work and time by staff, but the key is finding how the EMS will make their work easier, make the workplace safer, and/or address problem(s) in their area. Here are some keys to success.

- Look for ways within your hospital's culture to show how the EMS advances the hospital's mission. If cost cutting is a key factor that motivates people, show how the EMS will save costs. If patient care and staff safety is key, show how you see the EMS accomplishing this.
- Ask resistors for possible environmental problems in their area(s) and use the EMS as a way to fix these problems. Once you start working on these issues, they're no longer problems but rather opportunities for changing attitudes and winning people over.
- Listen to vocal resistors but be even more aware of those who say nothing or agree very easily. Generally, vocal resistors will vent, get on board and exceed what you ask of them. Silent resistors or those who agree very easily tend to fall short of expectations.
- Whenever possible, recognize those individuals that make success possible. Use your hospital's newsletter and any other form of staff appreciation that your hospital has to acknowledge these individuals.

- There is no question that changing people's attitudes is difficult and can take a long time. Communicate success back. Success changes attitudes. Organizational culture evolves over long periods of time. But remember, "If you don't succeed, try and try again!"

Choosing your EMS Representative(s)

Depending on your management structure there are a number of ways of delegating responsibility for developing your EMS. In some organizations, there are two individuals coordinating all aspects of the EMS, usually an existing hospital management representative (at the Director or VP level) functioning as the EMS Management Representative and an Environmental Coordinator/EMS Specialist (at middle management or specialist level). The Environmental Coordinator/EMS Specialist performs the majority of EMS procedure development and hospital communications. In turn, the EMS Management Representative, with the ability to allocate funds, approves all resulting EMS related procedures and programs. This structure ensures there is a hospital management representative with knowledge of EMS overseeing the performance of the Environmental Coordinator/EMS Specialist and the overall system performance. In contrast, examples have shown that many industries designate one position within the facility to perform all EMS functions and directly report back to the company's Senior Management. Choose what is right for your organizational structure.

EMS Management Representative

At two EMS hospitals, the Senior Management position responsible for materials management and support services (i.e. housekeeping, maintenance, nutrition, purchasing, sterilization, waste, health and safety, etc.) was appointed as the EMS Management Representative. The reason behind this was that many of the perceived "high risk" or environmentally "significant" issues fell within these departments.

The responsibilities of the EMS Management Representative are:

- Provide leadership in environmental management and environmental performance.
- Ensure that the resources (i.e. human, physical and financial) essential to the implementations and continuation of the EMS are available.
- Review and define employee roles and responsibilities as they relate to the EMS.
- Provide feedback and sign off on EMS Team requests.
- Report on the performance of the environmental management system to top management for review and as a basis for improvement.

Do you have someone at your hospital that fits into this role?

INTEROFFICE MEMO

TO: Hospital Staff CC:

FROM: President CONCUR:

DATE: 8/13/98 REPLY: NO

SUBJECT: ISO MANAGEMENT REPRESENTATIVE
APPOINTMENT/APPROVAL

As President at [insert hospital name and location] I appoint [insert name] to assume the responsibilities as the ISO 14001 EMS Management Representative and [insert name] to assume the responsibilities as the ISO 14001 EMS Management Representative Alternate. Responsibilities and reporting functions will be consistent with those outlined in [insert hospital name] EMS Policies and Procedures.

[signature]
President

Environmental Coordinator/ EMS Specialist

When selecting your Environmental Coordinator/EMS Specialist, consider three main things:

1. Knowledge of environmental programs and issues,
2. Knowledge of the ISO 14001 standard, and
3. Experience in developing and leading training sessions.

If you have existing ability or interest in-house, the role of Environmental Coordinator/EMS Specialist could be given to a staff member (possibly someone in your health and safety department with environmental interest). If not, you will have to hire someone to fulfill the role (which is often the case). With EMSs being so new in the health care sector, it would be rare to find an individual with both hospital knowledge and EMS experience. Most likely, you will need to find someone with environmental knowledge and teach this individual about the healthcare industry.

Consider hiring a student to develop your EMS, perhaps recruit local college students with an interest in the environment and knowledge of ISO 14001 to help with EMS development. You can get an enthusiastic individual with the knowledge and skills for performing the duty at a reduced cost of hiring a professional. Look to see if one of your local colleges has an environmental program, then go from there.

Choosing Your EMS Team

In health care, it is a common practice for management to assemble multi-disciplinary teams of hospital staff, including front-line workers, for development and implementation of new patient care programs. Likewise, a multi-disciplinary "Green Team" can be developed to help with developing EMS objectives and targets, environmental awareness programs, decision-making, research, and staff communications.

When deciding who will be a member of your hospital's "Green Team" think through and identify departments where you traditionally have many environmental issues. From this initial evaluation, you may find it beneficial to have keen individuals with knowledge and experience in these "significant" areas on the Green Team. For

example, many facilities take on waste management issues as an initial EMS objectives or environmental program (considered "low-hanging fruit" with possible substantial cost-savings and environmental payback). Typically housekeeping has handled waste management and would be a key participant to involve in meeting the objective.

Secondly, it is essential to have representation from management and from those departments that affect the decision-making process of environmental programs. A case in point is the purchasing department. Purchasing is often responsible for products, services, and equipment brought into your hospital, has close relationships and communicates with contractors and suppliers on a regular basis, and is closely linked to your finance department. Furthermore, purchasing can be a key player in "green procurement" which is critical when working on topics as PVC medical supplies, mercury thermometers, and disposable vs. reusable products. Likewise, the highest occupation group at your facility will probably represent medical and/or nursing staff; for this reason you will also want a nurse-representative on your team.

In planning your EMS you may also want to have a member from your financial department on your Green Team. The reason being, that when you are determining your hospitals significant aspects and impacts the member from your financial department can provide specific cost information for different processes and procedures. This type of accounting for information related to specific environmental activities is called Environmental Management Accounting.

Environmental Management Accounting (EMA) serves hospital administration in making capital investment decisions, process/product design decisions, and performance evaluations. EMA differs from traditional accounting by including societal and private costs across the entire life cycle of an activity or use of a product. This accounting provides a more accurate cost assessment during the significance determination step in an EMS. Visit www.epa.gov/oppt/acctg/indexold.html for more information.

Last, but definitely not least, it is important that the members of your Green Team exhibit interest in environmentally related issues and programs and have a willingness to contribute during meetings. However, keep in mind that like most new committees

working with relatively new subject matter, it may take a few meetings to get your group feeling comfortable with one another, the topics, and an open discussion format.

In addition to purchasing, the following are areas from which you should consider having both management and worker representation for your Green Team.

- Nursing (It would be beneficial to choose two nurses as delegates for each other, representing different key departments such as Emergency, Surgical, and Medical areas. In the event one nurse can not attend, perhaps the other would be able to stand in.)
- Housekeeping/Environmental Services/Waste Management
- Engineering/Maintenance
- Physicians
- Laboratory and/or Diagnostic Services
- Health and Safety
- Educational Services
- Risk and Quality Analysis

Green Team Expectations

The role your Green Team plays in EMS planning and implementation can be different from site to site. The following is a list of possible responsibilities for your Green Team:

- Aid in the identification of environmental aspects, associated impacts, and determination of significant aspects;
- Provide input into the development of environmental objectives and targets; Environmental Management Program(s), and other related EMS programs (i.e. members as “champions” of certain objectives);
- Assist in the development and maintenance of EMS documents, particularly work instructions that may apply to their area;
- Aid in the identification of the training needs of the hospital. Train individuals in their work areas on the EMS, the environmental policy, objectives and targets applicable in their work areas, and work instructions that need to be followed to

meet the objectives and targets or otherwise follow to minimize environmental impacts;

- Facilitate communication with front line staff concerning environmental issues and relevant sections of the EMS. Direct questions, issues and any external communications to the EMS Representative(s);
- Provide input about current or predominate environmental issues that may effect the hospital;
- Build enthusiasm around the hospital about environmental performance, programs, and changes; and
- Make recommendations for continual improvement in the hospital's environmental performance.

These responsibilities should be clearly explained and communicated to all members during the first few Green Team meetings so as to ensure that everyone is clear of their role and the focus of the team.

Meeting Structure

The Green Team should meet monthly as various components of an EMS require input from your team on a fairly regular basis. However, if you are not able to organize meetings at this frequency, utilize inter-hospital communication modes such as email and inter-departmental mail for updates and feedback. Set meeting agendas and keep to them. People get less and less attentive if meetings continue past the allotted time. Designate a "minutes" taker. These minutes are used as proof of meetings and discussions when being audited by your Internal Auditing team, (to be discussed later in this guide) and your EMS external auditor if you plan to become ISO 14001 registered. Develop a committee "Terms of Reference" or a formal document outlining the roles and responsibilities of the team. Incorporate input from the individuals on the team and the requirements of the ISO 14001 standard into the document. Use this document to focus meetings and to set agenda items. Review this annually with the team to incorporate any changes that have occurred within the last year to the EMS (this is a requirement for an ISO 14001 registered facility).

Education

It is essential to provide extensive EMS-related training to the team, so that they are aware of EMS requirements and definitions (e.g., environmental aspects and environmental impacts), and the goals set forth in the hospital's environmental policy. Provide this education up front at your first few meetings to ensure that all members are on the right track. Use examples, examples and more examples! If possible, ask your President/CEO or EMS Management Representative to say a few words at your first meeting about why the hospital has chosen to commit to this program, and to encourage your members.

Facilitating Open Communication

Promote open dialogue and communication among members. Possibly start off your first Green Team meetings with "ice breakers" to introduce the members to one another. Incorporate short activities into the team's agenda to facilitate members discussing environmental issues in healthcare, in their communities, in their neighborhood(s). Open discussion of topics and issues is essential to the progression of the EMS and the success of the Team's goals. As an EMS administrator (or management representative) you don't want to be the only person discussing topics at the meetings so, encourage open communication by providing education, information and an inclusive environment during meetings.

Reporting Structure

The Green Team should report back to the EMS Management Representative as often as is required by your facilities reporting structure (i.e. quarterly updates, monthly reports, and annual reports). When the team is focusing on specific EMS-related decisions such as recommending/setting environmental objectives and targets, they will need to report back to Senior Management for budgeting approval.

Legal and Other Requirements

Unlike many other EMS components we'll see, Legal and Other generally stays under the EHS specialist or EHS committee due largely to the specialized nature of what

day-to-day environmental compliance (e.g., paperwork, permits, reporting) requires. You are aware of many federal, state, and local requirements already through your compliance efforts. Building on this list is key to the success of your EMS and likely only a matter of consolidating information already at your fingertips. Any current lists of permitted or otherwise regulated activities and service are good starting points.

Early on, realize that increased compliance assurance may be one of the most important reasons your administrators have for backing the EMS. Consequentially, it may be one of the areas they want to see an early return on for the money they are investing in an EMS. If so, this is an important expectation to recognize and address through your work; a compliance audit can help. There are other practical reasons to look at compliance early in the EMS. Compliance is assumed in EMS organizations. It's the minimal level of environmental performance, and if you're not meeting compliance requirements, it could mean regulatory fines, penalties, and less-than positive publicity. Second, addressing any possible compliance concerns at this point prevents them from arising later and diverting needed resources, time and attention from EMS implementation; it's tough to get EMS implementation back on track if people lose focus. Successfully addressing any compliance issues through the EMS builds staff support. Seeing the system fix compliance problems builds credibility that the system can help with other environmental problems they would like addressed in their work areas. Finally, if there is not a specific EHS specialist who does environmental compliance within your organization, it may bring necessary management attention to the fact and help make this happen.

Federal, State, and Local Requirements Commonly Applicable to Hospitals

ASPECT	POTENTIAL REQUIREMENTS	CITATION
	GENERAL REQUIREMENTS	
Material usage	Hazardous Substances and Reportable Quantities	40 CFR Part 302
	Hazardous Chemical Reporting (SARA, Title III, PPA)	40 CFR Part 370
	PCB Management	40 CFR Part 761
	AIR REQUIREMENTS	
Air emissions	Clean Air Act	40 CFR Parts 50-61
	State Clean Air Act Requirements	401 KAR Chapters 50, 52
	Stratospheric Ozone Protection/CFC Containing Equipment	40 CFR 40 CFR Part 82
	Asbestos Management	40 CFR Part 61
	Asbestos	401 KAR Chapter 58
	Clean Air Act Permitting Requirements	401 KAR Chapter 52
	State General Standards of Performance	401 KAR Chapter 63
	New Source Performance Standards for Hospital/Medical/Infectious Waste Incinerators constructed after June 20, 1996	40 CFR Part 60 Subpart Ec
	State Regulations Regarding New Medical Waste Incinerators	401 KAR 59:020
	Emission Guidelines for Hospital/Medical/Infectious Waste Incinerators constructed on or before June 20, 1996	40 CFR Part 60 Subpart Ce
	Federal Plan Requirements for Hospital/Medical/Infectious Waste Incinerators constructed on or before June 20, 1996	40 CFR Part 62 Subpart HHH
	State Regulations Regarding Existing Medical Waste Incinerators	401 KAR 61:010
	NESHAP for Commercial Sterilization and Fumigation Operations	40 CFR Part 60 Subpart O
	WATER/WASTEWATER QUALITY REQUIREMENTS	
Water discharge	Wastewater Discharges	40 CFR 403, 401 KAR 5:557, and relevant local ordinances
	EMERGENCY RESPONSE REQUIREMENT	
Material usage, potential spillage and releases	Emergency Planning & Notification	40 CFR Part 355
	Underground Storage Tanks	401 KAR Chapter 42
	WASTE REQUIREMENTS	
Solid and liquid waste generation	Hazardous Waste RCRA	40 CFR 264-265
	Standards Applicable to Generators of Hazardous Waste	401 KAR Chapter 32
	Land Disposal Restrictions	40 CFR Part 268
	Toxic Substances Control Act	40 CFR Part 700
	Regulations governing disposable waste including sharps, blood, and blood-containing waste	902 KAR 20: 016
	Universal Waste	
	PCB Waste Management	40 CFR Part 761

Although EMSs do not guarantee compliance, they do make it more likely you will achieve and maintain compliance. An EMS requires your organization to identify and have access to your environmental legal and other requirements. Most organizations track this information in a table or matrix, electronically or on paper. Your list should include the regulatory citation and a plain-English description of what the requirement is. Once you have this list, you should conduct a compliance audit against the requirements, identify potential compliance issues, and fix them, ideally through the checking and corrective action system. Knowing where you go and what resources you use to stay up-to-date and current is the Legal and Other requirement. Commonly used resources include the following.

- Legal counsel such as attorneys
- Regulatory field inspectors or HQ personnel
- Hospital trade association workshops, newsletter, and publications
- Environmental journals
- Commercial updates and databases
- State or provincial pollution prevention technical assistance providers
- Environmental consultants
- Web sites
- Contractors and suppliers

'Other' requirements include voluntary requirements, codes of practice, standards, etc. that relate to the healthcare environment. One example is the Joint Commission on the Accreditation of Healthcare Organization's (JCAHO's) Management of the Care of the Environment standard. It provides guidelines on environmental issues such as emergency planning and preparedness, also covered under the ISO 14001 standard. Are there other industry codes or programs that apply to your organization?

Legal and other requirements ties to other EMS areas we'll talk about including-training, compliance auditing (as found under monitoring & measurement), checking and corrective action, and management review. We'll cover each in turn.

- The legal and other requirements you identify are associated with various environmental issues, or aspects, at your organization. Consequentially,

identifying all your environmental legal and other requirements will help greatly later working on your list of environmental aspects.

- Monitoring and measurement's compliance auditing. Compliance is one part of environmental performance and an EMS requires you check it. There are two times to think about compliance auditing. The first time is now when you are starting EMS implementation. Audit your organization against your list of legal and other requirements. Potential problems you find can then be written down and fixed as part of your EMS checking and corrective action (see section below). Generally, once the EMS is in place, you'll want to audit compliance at least once a year. In both instances, you may choose to use an outside consultant.
- Training. You may have various aspects of environmental compliance training in place now that ensures your staff perform their duties in such a way the hospital continues to stay in compliance. Your existing environmental training, ensures people know the "why" of their roles and responsibilities as well the "how-to." Tying the "why" to environmental benefits such as community and patient health, which is core and central to the healthcare mission, is apt to receive positive and long-lasting support.

    Example: Employee: Housekeeper transporting Biomedical Waste – "Why?" Because this person is working with a highly regulated waste class that if spilled can potentially cause both environmental and health risks to that individual and those around him/her. "How-to" ensure that storage containers are leak-proof and appropriately labeled, internal transport containers are well-maintained, staff wears appropriate PPE and handles bags with extreme caution, and waste is stored in locked storage area before transport

    - Use your training as an opportunity to provide positive feedback on how people are doing. At one facility, the production supervisors successfully worked with people on the production floor to recycle and reuse Styrofoam wrappers, saving thousands of pounds of waste and saving $100,000 annually--critical in its industry where contracts could be won/lost based on $1/100^{th}$ of a cent differences per bid part. However, the EHS specialist provided no positive feedback, drawing the rather severe response of the supervisors. People like to know and need to know if their efforts are paying off! This is critical with an EMS.

- Management review. An EMS requires you have management review, which we'll cover later in more detail. Suffice it to say, that one of the things that's good to cover is an update on compliance efforts and any upcoming changes in regulatory requirements you see for your organization, particularly if you see any significant expenditure or staff time that will be needed.

Audits

Internal EMS audits and compliance audits are the next key places to start working on for the EMS. The reason for auditing and a corrective and preventive action system is two-fold. First, no EMS is perfect. You will have nonconformance's—times when your system is not performing as you said it would in your documentation and times when your system is not meeting an EMS requirement in the ISO 14001 standard (important if you seek ISO 14001 registration). Second, things change in your organization. You may change operationally, bringing new chemicals, activities, products or services into your hospital. These can change your environmental impacts. Auditing helps catch these so you can manage them in your system, keep the system operating as intended, and continually improve your environmental performance.

Types of audits

There are several different audits when it comes to an EMS: compliance audits, gap audits, and internal EMS audits. They are frequently confused but, in fact, serve very different purposes.

Compliance audits compare your performance with a set of environmental requirements (i.e., your table of legal/other requirements) relying largely on following a paper trail of permits, sampling data, and reports. EMS audits drive continual improvement by checking your system's performance against how you said the system would work in your documentation and, in the case of an ISO 14001-aligned EMS, against the ISO 14001 standard. While reviewing paperwork also, EMS audits have a greater focus on interviewing employees from various levels and job functions within the organization and assessing actual environmental performance.

We cover compliance and compliance auditing now, rather than later in implementation, for several reasons. First, compliance is considered the baseline, or the minimally acceptable, level of performance in an EMS organization. Your administrators may want to know where things stand on compliance before agreeing to take on an EMS. Alternatively, they may want to implement an EMS because it will put some mechanisms in place that make environmental compliance more assured. Second, compliance issues that come up later can divert needed resources, time, and attention from EMS

implementation that make getting the EMS back on track very difficult. Lastly, conducting a compliance audit can point to the need for more staff. If there is not a specific compliance person or group within the organization, it brings necessary management attention to the importance of maintaining compliance in the face of frequently changing regulations. Many EMS organizations check compliance annually once the system is up and running. You may want to communicate compliance audit findings on a more limited basis than findings form the gap and EMS audits.

Gap audits

Gap audits are done early and simply identify the EMS components your organization has in place and areas of needed improvements. You may wish to do an EMS gap audit at your hospital and present the results during your initial meeting with Senior Management and the Board of Trustees. In some organizations, Senior Management prefers to conduct the gap audit prior to deciding whether to do implement an EMS. In either case, an effective gap audit allows you to focus time and attention on those areas needing the most effort. An example gap audit checklist developed by the Kentucky Pollution Prevention Center is included for your use in the Resources section of this manual.

Effective auditing tips and techniques

Setting the right tone with audits off the bat is key if you want to see your audits drive continual improvement. Audits help your EMS get better and improve environmental performance. Punitive repercussions from audits should be avoided; audits are about finding ideas and ways to keep improving. There are many classes covering the technical aspects of effective auditing techniques (see resources at end of section); however, effective people skills are just as important and should be considered whether you are setting up an internal auditor team or selecting an outside contractor to conduct audits. Your auditors will interact with many in the hospital. The perceptions your auditors create with people should reflect positively on your EMS efforts. Some things to consider follow.

- Recognize that auditing may be an imposition on the people you are auditing.
- Look around for people in your hospital who have audit experience. Their familiarity with auditing will be an asset even if you need to provide them with environmental training to get them up to speed. They will likely be familiar with how to approach people they audit and put them at ease.
- Depending on the size of your hospital and the nature of the auditing, you may choose to send teams of auditors out into the hospital. Consider putting at least one experienced auditor on each team. Two to three auditors per team allows for one person to be asking questions/writing responses and at least one other to be observing what's going on in the work area. Early in EMS auditing, sending auditors in teams provides assurance to team members they are not out there "on their own" and have someone to confer with for if questions come up. Two pairs of eyes are better of one.
- Good listening and effective questioning are key in the auditing process. "Yes/No" questions make people liars 50% of the time and fail to provide you the auditor very much more than what you had before you asked the question. Ask "how" questions. People generally like to talk about what they do in their job. "How" questions help them do this and help you as an auditor obtain more information about what's really going on.
- Audits are like an "open-book" test; auditees can use resources around them to answer auditor questions. Information doesn't have to be memorized.
- Provide advance notice to areas well in advance of audits. People generally do not like surprises, particularly when they are in the form of an audit. One EMS representative set the audit schedule for areas six months in advance and then would send reminders two weeks and then one week before the audit.
- Set an audit schedule and stick to it. Recognize audits are a sample. You won't be able to look at every record or talk to every employee. Sampling helps you keep on schedule and on time to areas you are to audit.
- Conduct questioning with in your level of knowledge and scope of the audit.
- Report in terms of departments or areas you have audited, not in terms of individuals. Audits are not meant to get people in trouble.

- Audit findings can be positive. Be positive on people's accomplishments. Pay compliments when in order.
- Audit teams disagreements should be done outside of the auditee's presence. During an audit with an ISO 14001 registrar an EMS auditor trainee with a quality management background began asking quality questions. The lead senior auditor asked for a "sidebar" with the trainee auditor and stepped out of earshot of the auditees. When the two returned, the trainee auditor was back on track asking environmental and not quality, questions.
- Look at the experience of your auditors. If you are hiring an auditor in, look to see if they have any healthcare experience. Auditor familiarity with healthcare coming in can mean a more focused audit for your organization.
- Don't let company politics interfere with the audit.

You should feed audit findings (compliance audits, internal, and external (if ISO 14001 registered)) into your corrective and preventive action system to get fixed. This helps build your system and continually improve it. In both cases, EHS managers typically find that documenting problems, needed resources including peoples' time, and roles and responsibilities for implementing solutions helps tremendously in getting things done. One EHS manager indicated this as the single biggest benefit of implementing an EMS: things started to get done environmentally through the documented, assigned accountability. The corrective and preventive action is also the single biggest reason many environmental regulators support EMSs.

Corrective and preventive action systems

Audits are a good source of continual improvement opportunities. Over time, however, there will be other sources you can look to for these opportunities including incident reports, tracking performance against objectives and targets, monitoring and measurements, hospital employees, visitors, and other hospital stakeholders. Day-to-day EMS implementation and administrative reviews will reveal other system and environmental performance opportunities. As your organization changes and grows, there will be improvement opportunities. While these may be communicated to you

informally, there should be a formalized way of recording these to ensure they are considered and then possibly handled in your corrective and preventive action system also. One facility used the communication form at the end of this section. Completed forms would then be forwarded to the EHS department for review and to be possibly written up for corrective action. Audit non-conformances would be written up automatically for corrective action. The example procedures outline how audit non-conformances can be handled. Section or work area managers are typically, but not always, responsible for determining and implementing corrective or preventive action and reporting back on progress.

Begin implementing your checking and corrective action system early in the EMS process. An effective checking and corrective and preventive action system requires you to have a procedure to accomplish the following.

- Investigate actual or potential problems. Initially you may be playing catch-up, fixing things needing fixed. But eventually as you have your system in place, this part of your system will hopefully shift to preventing problems, keeping fires from happening, instead of putting them out. Be sure to look at your non-conformances for patterns. This should be done in the EMS Management Review. Knowing these trends will help anticipate and prevent potential future problems.
- Identify and write down root causes of problems such as non-compliance. Sometimes getting at the root cause requires digging below the surface to determine why the problem occurred.
- Identify, track and document corrective and preventive actions. This involves writing down what resources you need to correct the problem, implementing an action plan/solution to prevent reoccurrence, defining needed resources, and indicating what action(s) were ultimately taken that fixed the nonconformance. Several example corrective and preventive action procedures and forms are shown.

Title: *EMS-4.3.2 PROCEDURE FOR LEGAL AND OTHER REQUIREMENTS*		
Document No: *EMS-4.3.2*	**Prepared By:**	**Approved By:**
Date Approved: *06/01/02*	**EMS Representative**	*EMS Management Representative*
Next Revision Date: *06/03*		

1. Purpose

1.1 To ensure that appropriate persons have access to and understand all legal and other requirements that are applicable to the environmental aspects of [*insert hospital name*]'s activities are met.

2. Scope

2.1 This policy governs the operations and programs conducted by [hospital name], located at [*insert hospital address*].

3. Responsibility

3.1 It is the responsibility of the EMS Representative and/or designate to ensure that all legal and other requirements are kept up-to-date and to inform staff of the legislative, regulatory and other requirements that the hospital must comply with.

3.2 It is the responsibility of the Department Managers/Supervisors to implement new or to revise existing programs or operations to meet applicable regulation requirements and to ensure that their employees are aware of the legislation, guidelines, regulations, etc., that effect their area(s) of operation.

It is the responsibility of all employees of [*insert hospital name*] to inform the EMS Representative and/or designate should they learn of new and changed legislation and other requirements.

4. Procedure

4.1 The EMS Representative and/or designate is responsible for identifying and documenting the legislative and other requirements associated with the hospital's significant aspects.

4.2 The EMS Representative and/or designate is responsible for identifying new or changed legislation, regulations and by-laws by reviewing the Federal, State and Municipal legislative web-sites, and any other tools that may be available for updating compliance, on a regular basis.

4.3 The EMS Representative and/or designate retains copies of applicable environmental legislation for referral. Copies of legal and other requirements are

retained in the Environmental Legislation and Regulations Binder. Obsolete documents are discarded when new changes are made.

4.4 Affected Department Managers must communicate and implement changes that occur as a result of amendments to legal or other requirements within their departments.

4.5 The EMS Representative, in collaboration with associated management, will address legislative or other changes that affect the hospital corporation and/or non-specific departments.

4.6 In the incidence of non-compliance with changes in regulatory requirements, the EMS Representative and/or designate, in consultation with Department Managers/Supervisors, will create a corrective action plan to address the issue(s).

5. Definitions

5.1 Definitions relating to the content of the EMS are contained in the Glossary.

6. References

ISO 14001 - 96 - Environmental Management System Standard

7. Exhibits

N/A

(CONFIDENTIAL) [hospital name]	STABDARD NUMBER: ENV-001	ISSUE DATE:	ISSUE NUMBER: 1	PAGE:
CLASSIFICATION: ENVIRONMENTAL STANDARD	TITLE: Regulatory Compliance Audits		DRAFTED BY:	APPROVED BY:

Regulatory Compliance Audits

1.0 Purpose/Scope

This procedure defines the mechanism for the planning and implementation of regulatory compliance audits at [hospital name].

2.0 Activities Affected

All areas and departments

3.0 Forms Used

3.1 Audit Checklist
3.2 Corrective and Preventive Action Request (CAR)
3.3 Internal Environmental Audit Summary Report
3.4 Audit Schedule

4.0 References

4.1 Non-conformance and Corrective and Preventive Action
4.2 Environmental Management System Management Review
4.3 ISO 14001:1996, Elements 4.5.1 and 4.5.4

5.0 Definitions

5.1 Auditee: individual audited.
5.2 Auditor: audit team member performing the audit.
5.3 Audit Criteria: policies, practices, procedures or other requirement against which the auditor compares objective evidence about the subject matter.
5.4 Audit Program Leader: individual responsible for maintaining the Environmental Audit Program.
5.5 CAR: corrective and preventive action request that identifies observed non-conformances.
5.6 Finding: an existing condition supported by objective evidence.
5.7 Non-conformance: the non-fulfillment of specified system requirement.

5.8 Objective Evidence: qualitative or quantitative information, records, or statements of fact pertaining to the existence and implementation of an EMS element which is based on measurement or test and which can be verified.

6.0 Exclusions

None

7.1 Conducting the Compliance Assessment Audit

7.1.1 The EMR or designee is responsible for planning, scheduling and implementing internal environmental regulatory compliance assessment audits, including the identification of required resources.

7.1.2 The EMR or designee develops and maintains the environmental compliance assurance program and issues program support documents, based on company environmental compliance assurance guidelines, where available.

7.1.3 During a compliance assessment audit, assessment team members will record information, such as: items checked, individuals interviewed, any possible regulatory non-compliance issues. The assessment team shall promptly notify the Environmental Management Representative or designee of any possible regulatory non-compliance. Upon verification of non-compliance, the Environmental Management Representative shall notify facility management.

7.1.4 The assessment team reviews possible regulatory non-compliance issues with the responsible and accountable area department representative. The team also prepares a CAR identifying the issues, corrective and preventive actions required, and the individuals responsible for completing the actions. The EMR or designee and area or department manager will concur with the CAR before its issuance.

7.1.5 Upon completion of the corrective and preventive action, the area or department manager will acknowledge completion of these actions by signing the original CAR and returning it to the EMR or designee.

7.1.6 A member of the assessment team will verify corrective and preventive actions in a timely manner. When full compliance is determined or corrective and preventive actions accepted, the assessment team member will sign the original CAR and return it to the EMR or designee for the closure and filing.

7.1.7 Each calendar quarter, the EMR or designee will present a summary of open CAR's that are based on regulatory non-compliance to facility management for review.

8.0 General Rules

8.1 Records, including CAR's, relating to potential or actual non-compliance issues will be treated as confidential and will be kept separate from those relating to internal EMS audits.

8.2 Potential non-conformance issues (Note: a non-compliance is a non-conformance) must receive prompt attention and timely corrective and preventive action.

8.3 All audit records shall be marked "Environmental Audit Report: Privileged Document" (US only) and distributed to individuals with a need to know their contents in order to assess, respond to or remedy a potential or actual non-conformance.

9.0 Records

Records shall be retained consistent with Record keeping procedure.

Record of Revisions

Revision Date	Description	Sections Affected

Title: *EMS-4.5.2 PROCEDURE FOR NON-CONFORMANCE, CORRECTIVE AND PREVENTIVE ACTION*		
Document No: *EMS-4.5.2*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: *07/25/02*		
Next Revision Date: *07/03*		

Purpose

1.1 To ensure that a process is in place to define responsibility and authority for handling and investigating non-conformances, taking action to mitigate resulting impacts, and for initiating and completing corrective and preventive action.

Scope

2.1 This procedure applies to the operations and programs conducted by [insert hospital name], located at [insert hospital address].

Definitions

3.1 Definitions relating to the content of the EMS are contained in the Glossary.

Responsibility

4.1 It is the responsibility of the EMS Representative and/or designate to:

- to lead the Environmental Auditing Team to find hospital non-conformances;
- investigate the occurrence of non-conformances;
- to aid in the development, follow through, and evaluation of corrective/preventive actions in consultation with the Department Managers/Supervisors;
- to revise EMS procedures as a result of non-conformances; and
- organize staff re-training, when needed.

4.2 It is the responsibility of the Department Managers/Supervisors to:

- verify the occurrence of non-conformances within their departments;
- to identify and follow through with corrective/preventive actions;
- to evaluate the effectiveness of the corrective/preventive actions taken; and
- to prevent reoccurrence of non-conformances**.**

Procedure

5.1 Non-conformances can be identified by:

- Internal/external audits (EMS- 4.5.4),
- Compliance audits (EMS- 4.5.1),
- Regulatory inspections (EMS-4.3.2)
- Observation by staff members,

- Internal/External communications (EMS-4.4.3),
- Review of emergency preparedness and response procedures after the occurrence of a spill or environmentally related accident (EMS-4.4.7), and
- Management review process (EMS-4.6).

5.2 Non-conformances identified not through an EMS Audit are to be recorded on the hospital's current "Employee Incident Reporting Form" and/or an employee can contact the EMS Representative to report the non-conformance (will be documented on an Employee Incident Reporting Form".

5.3 When the EMS Internal Auditing Team uncovers a non-conformance during an audit, the non-conformance is formalized and documented in the EMS Audit Report. Identified non-conformances are also documented on the "Non-conformance Corrective Action Report" and sent to the associated Department Managers/Supervisors for remediation.

1.4 The EMS Representative and/or EMS Internal Auditing Team conducts an initial severity evaluation of the non-conformances identified to determine if it is a MAJOR or MINOR non-conformance:

- "MAJOR- a serious, possibly reoccurring deficiency within the EMS that adversely affects the hospital (i.e. a missing requirement of the ISO 14001 standard, and/or a system is not functioning as it is documented).

  - Requires documented corrective and preventive actions.

- MINOR- an isolated deficiency in the functioning of a system that does not affect the performance of the hospital's overall EMS (i.e. a documented procedure is not followed consistently, and/or a part of a procedure is missing).

  - May not require documented corrective and preventive actions."

(Taken from St. Mary's General Hospital's EMS, Kitchener, Ontario, Canada, 2001)

1.5 The EMS Representative and/or associated Department Managers/Supervisors addresses major and minor non-conformances as they occur.

1.6 For Major non-conformances, the associated Department Manager/Supervisor, EMS Representative, and/or other responsible position identifies and documents corrective and/or preventive actions in the "Correction" section of the Employee Incident Reporting Form. Proposed actions, responsibilities, and target dates are to be included in this corrective and/or preventive action plan.

1.7 The EMS Representative and/or a management representative approves corrective and/or preventive actions.

1.8 Department Managers/Supervisor and/or delegated departmental staff follow through with identified corrective/preventive actions.

1.9 If the non-conformance relates to EMS documentation or legislative and other requirements, the EMS Representative will proceed with the identified corrective and/or preventive actions.

5.10 The EMS Representative conducts a follow-up inspection/audit/review to determine is corrective/preventive action(s) have been completed and are effective.

5.11 If hospital staff identified the non-conformance the EMS Representative will report progress back to the initiating staff member within two weeks.

References

ISO 14001 - 96 - Environmental Management System Standard
EMS-4.3.2- Procedure for Legal and Other Requirements
EMS-4.4.3- Procedure for Communication
EMS- 4.3.7-Procedure for Emergency Preparedness and Response
EMS- 4.5.1- Procedure for Monitoring and Measurement
EMS-4.5.4 Procedure for Environmental Management System Audits
EMS-4.6 Procedure for Management Review

Exhibits

N/A

NONCONFORMANCE/RECOMMENDATION FORM

As per Section 4.5.2- Nonconformance, Corrective and Preventative Action of the hospital's Environmental Management System (ISO 14001), all *major nonconformances identified through the process of internal inspections (performed by the EMS Internal Auditing Teams) must be documented, have corrective/preventative actions identified, responsibilities designated and timelines set for remediation.

Department: ***ENGINEERING SERVICES/LABORATORY*** **Program Manager/Supervisor:** ***BILL JONES***

Return Form To: ***EMS REPRESENTATIVE*** **By Date:** ***(2 weeks from Audit Date) APRIL 15, 2002***

Audit Team: ***SALLY WILSON, JOE PALMER,*** **Audit Date:** ***APRIL 1, 2002***
MELISSA LEVIGNE, PAUL TAIT

Nonconformance ***(Site section of Standard / EMS in contravention)***	**Recommendation(s)**	**Corrective / Preventative Actions**	**Dates of Completion**
4.3.1- Aspects and Impacts *- Manager audited were unaware of their responsibilities to update the aspects list annually.*	***Increase awareness through education (managers meetings and emails).***	*- Attended Manager's Meeting on May 23, 2002 to discuss Aspects updating process. Managers were given a copy of their department and are to respond with any changes by June 30, 2002.*	- *May 23, 2002 – Managers Meeting* - *June 30, 2002 – Receive all updated aspects list* - *July 19, 2002 (have aspects list updated).*
4.3.1- Aspects and Impacts *- Managers were unaware of their responsibilities to inform the EMS Representative of any new products/equipment that may have a significant impact on the environment.*	***Increase awareness through education (managers meetings and emails).***	*- Same as above*	- *Same as Above*

* ***Major Nonconformance***: a serious, possibly reoccurring deficiency that adversely affects the Hospital, a missing requirement of the CAN/CSA ISO 14001: 1996 Standard, a system is not functioning as it is documented. Requires documented corrective or preventative actions.

Problem Identified: June 2001	Resolution Due Date: July 2001
Problem Identified By: Laboratory Supervisor	

Problem (described existing or anticipated problem): EMS Management Team failed to conduct a cost-benefit analysis on implementation of new chemical tracking and inventory system, which was identified as an action item during the first quarter EMS steering committee meeting. Original due date for analysis was May 1, 2001.

Most Likely Cause(s):

- EMS Management Team focused on preparing for regulatory compliance audit during June 2000.
- Laboratory did not follow-up with EMS Management Team.
- Lack of information to estimate costs of implementing system above.

Possible Solution(s):

- Schedule working meeting between laboratory staff and EMS cost-benefit analysis team.
- Research chemical tracking and inventory systems (assign to laboratory staff) and report to EMS Management Team.

Implemented Solution(s):

Due Date: July 2001

Completed: July 2001

- Laboratory staff researched existing chemical tracking and inventory systems and reported to EMS Management Team on June 30, 2001.
- Laboratory and EMS cost-benefit team met on July 7, 2001 to discuss findings.
- EMS Management Team completed cost-benefit analysis on July 15, 2001 and plans to implement new systems are being determined cooperatively between laboratory staff and EMS team.

Resolution (confirm effectiveness of implemented solutions):

_____

Responsible Person

_____

Effective Date

Problem Identified: May 25, 2001	Resolution Due Date: May 30, 2001
Problem Identified By: Hazardous Waste Management Staff	

Problem (described existing or anticipated problem) Requires Corrective Action: Four of 17 drums of hazardous waste stored in storage area B behind the Maintenance Building were improperly labeled; one had no waste accumulation start date, two had no waste description, and one had no label.

Most Likely Cause(s):

- New employee in Maintenance Building started at the beginning of May and didn't receive training during first week of work.
- Laboratory where new employee works didn't receive phone number for waste management department to receive support in handling and storing waste.
- Supply of labels was low and existing labels were old and ineffective.

Possible Solution(s):

- Schedule and complete training for new employee(s).
- Meet with all laboratory managers in Maintenance Building to review hazardous waste management procedures.
- Provide new supply of labels and phone number magnets.

Implemented Solution(s):

Due Date: May 30

Completed: May 30

1) Trained new employee May 28
2) Conducted meeting with laboratory manager May 28
3) Re-supplied labels and magnets May 30

Resolution (confirm effectiveness of implemented solutions): Maintenance Building staff has been trained/briefed on hazardous waste handling procedures and no further deficiencies have been noted for 3 months. (Dates September 1, 2001)

_____
Responsible Person

_____
Effective Date

Pollution Prevention Opportunities For the Healthcare Industry

General Pollution Prevention Opportunities

Pollution prevention makes bottom line sense as these hospital learned.

- P2 efforts at Staten Island University Hospital reduced waste management costs by $500,000 per year.
- Mercy Healthcare of Sacramento purchases reusable liquid-proof surgical gowns and towels at six facilities, saving $60,000 per year and preventing 50,000 pounds of waste per year.
- Legacy Good Samaritan Hospital purchased several hundred permanent waterproof mattresses to replace 95 percent of disposable egg crate foam mattresses. The initial purchase was significant but the decision paid for itself in just one year. The savings in purchasing costs per year were $80,710. The disposal savings per year were $817 and prevented 16,350 pounds of waste annually.
- The Legacy Health System switched from paper/plastic blend disposable coffee cups to an all-plastic recyclable cup. Employees were encouraged to bring their own mug to the cafeteria for a discount. Savings in purchasing costs per year were $24,000. Savings in disposal cost per year were $1,417. Waste reduced was 28,333 pounds.

Solid Waste

A recent study found that hospitals generate close to two millions tons of waste per year. Seventy to eighty percent of this amount is solid waste, nearly half of which is paper and cardboard. The rest of the solid waste is primarily plastics (15 percent) and food (10 percent). Only 15-20 percent of a hospital's total waste generation is considered hazardous. However, non-hazardous waste is often placed in "red bag" or medical waste containers, unnecessarily increasing the cost of disposal and level of treatment needed for the waste.

Choosing to design solid waste reduction programs as one of your hospital's environmental objectives and environmental management programs is a great way to focus your efforts on proper waste segregation and minimization. Source reduction is preferred before you resort to implementing recycling options.

Source reduction is any practice, which reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or released into the environment prior to recycling, treatment, or disposal. Examples include environmentally preferable purchasing, raw material substitution, process or procedure modification, improvement in inventory control, training, maintenance, and housekeeping.

If you cannot eliminate the generation of waste, then evaluate **recovery, reclamation, reuse, and recycling** of wastes. Generally, recycling is the most common of all the available solid waste reduction options for hospitals. In order to have a successful recycling program, education is essential. Staff should be educated about proper waste segregation practices as soon as they enter the organization, in the hospital's orientation session, to ensure that they are aware of the hospital's recycling programs and the costs and liabilities associated with improper disposal of other hospital waste streams.

For example, in many of the hospital's fast-paced departments (Emergency, Operating Rooms, etc.) solid waste articles such as plastic packaging, cups, paper towels, boxes, gloves, etc., find their way into biomedical red bag waste containers. This costly practice can be avoided. To reinforce the need for solid waste reduction, look at strategically locating recycling bins in common solid waste generating areas and ensure that signage is large and visible. Here are a few areas you should consider for recycling bins.

Administrative and office areas - office paper, corrugated cardboard, other paper, cans, bottles.

Food service areas – glass, metal, cans, plastic containers, corrugated cardboard.

Public areas – newspaper, magazines, bottles, cans. Make sure that bins in public areas are well marked. Also if possible bins with specialized openings. Such as holes big

enough only for aluminum cans, slots for newspapers instead of large openings where it might look like a trash can.

Due to the such large quantities of paper and cardboard, many hospitals look to reusable totes. Reusable totes are most cost-effective when used to replace a constant cardboard need, such as distribution from central supply to satellite locations. Using color-coded, stackable containers makes this option much more feasible.

The Nightingale Institute estimated that approximately 19 percent of waste stream generated by surgical services is blue sterile wrap. Other hospital areas that typically generate considerable quantities of this waste include central distribution, purchasing, pharmacy, and labor/delivery rooms. This makes collection within the a hospital relatively easy. Because of the relatively low value of this material, attention must be given to keeping costs as low as possible especially once the material is collected internally. Identifying a local market for polypropylene or #5 plastics is key to minimize transportation distances. Establishing a low-cost collection and transport system and generating a significant quantity to warrant vendor cooperation are also important.

Another area in hospitals often overlooked is kitchen and food service operations. Although food waste itself represents only 10 percent of the hospital's waste stream, nearly 15 pounds of associated waste glass, cans, and cardboard are typically generated per patient tray of food. One option for food waste is to divert organic food waste to composting. When considering this option, look at space limitations and fitting the size of your composting to the amount of food waste generated. Obtaining management buy-in for employee support and properly running the composting bin both help overcome misconceptions associated with this recycling program. Case study examples suggest that properly-administered food composting systems can handle 100-300 pounds of food waste daily.

General Recycling Success Story

Thomas Jefferson University Hospital in Philadelphia has cut in **half** the amount of trash it sends to the landfill since implementing its program to recycle paper, glass, metal and plastic. This resulted in a savings of $150,000 a year in waste disposal costs. To educate and motivate staff, Support Services manager Ed Barr takes representatives of various departments on monthly visits to the landfill, where they sort through and audit the hospital's trash.

If source reduction and recycling are not feasible or possible, **proper treatment and disposal** is the next option. Neutralizing acids and bases and diluting alcohols for publicly owned treatment works (POTW) disposal are examples of waste treatment. The focus of this section is preventing waste.

Purchasing, Packaging and Solid Waste

Solid waste in hospitals often relates directly to purchasing practices. In these cases, implementing environmentally preferable purchasing (EPP) can greatly reduce solid waste. EPP is the purchase of products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose. EPP includes the total effect of the product including packaging, disposal, quality and cost.

Visit Hospitals for a Healthy Environment website for a How To Guide on Hospital EPP at http://www.geocities.com/EPP_how_to_guide/. The Massachusetts Office of Technical Assistance has an online copy of their EPP newsletter at www.state.ma.us/ota/otapubs.htm#eppnet. The Nightingale Institute for Health and the Environment has a new environmentally preferable purchasing tool at www.nihe.org. HealthCare Purchasing News Online at www.hpnonline.com has additional tips.

Environmental Purchasing Success Story

The University of Texas-Houston Health Science Center has made great advancements in using EPP. They provided The Natural Step (TNS) workshops to vendors and brought the vendors into partnerships to discover ways to help preserve the environment. The Health Science Center arranged with its office supplier to deliver supplies in reusable organic cotton bags instead of cardboard boxes. This step saved the University recycling and waste disposal costs. The Health Science center also replaced all mercury thermometers with alcohol thermometers and have worked to purchase radioactive chemicals with shorter half-lives. From Health Care EPP Network Information Exchange Vol. 2 No. 1 January 2000

EPP Options

Switching to bulk containers is an option and may require negotiating with your suppliers. One option is to join a Group Purchasing Organization (GPO). GPO's buy in volume for their member hospitals to achieve discounts on pricing. GPO's have significant buying power and can therefore be very instrumental in influencing environmentally preferred purchasing practices. Benefits of GPO membership for hospitals include reduced supply costs, product, standardization, and market leverage.

If you are a member of a GPO, raise packaging waste as an issue. Packaging costs the supplier also. In one instance, a medical supply distributor saved $22,500 annually in purchase of new cardboard boxes by saving and reusing boxes from its suppliers to ship its customer orders. Other benefits included reducing staff time to flatten boxes for recycling and assembling boxes for new orders.

Another way to improve purchasing is to create a Preferred Vendor Program. Any list of preferred products or vendors should have clear criteria so as not to raise unfair trade or liability issues. There are many ways to create a preferred vendor program. Some businesses require suppliers to do one or more of the following: be ISO 14001-registered, have an environmental management program in place, maintain and provide a current list of environmentally preferable products, or complete environmental impact questionnaire(s) for total operations or on each product line. Additional EPP practices follow.

- Purchase products in bulk.
- Purchase products with less packaging or reuse packaging.
- Take care in ordering "custom packs." While there is less waste on individual item packaging, waste from unused supplies can generate more waste. Negotiate through a purchasing alliance to exclude certain items in patient care kits that are repeatedly not used in patient procedures and become unused waste.
- Monitor requests for chemicals and implement policies to reduce over-purchasing that result in waste generation.
- Procure chemicals through a central department or person.
- Purchase smaller quantities of chemicals and supplies not frequently used.
- Purchase chemicals in totes or in recyclable containers.
- Control acquisition and use reagents that have limited shelf life. These supplies should be ordered in smallest practical container (e.g. ethyl ether and its formation of explosive peroxides).
- Avoid over-purchase of supplies. Order reagents and chemicals in exact amount to be used. Be careful when ordering extra quantities to take advantage of unit cost savings. You can lose the net savings by paying to dispose of unused chemicals.
- Encourage suppliers to become responsible partners by providing quick delivery of small orders and accepting the return of unopened stock such as sealed bottles of stable chemicals.
- Require an on-going relationship involving waste reduction with suppliers and purchasing alliance representatives.

Regulated Medical Waste (RMW)

Hospitals send millions of pounds of regulated medical waste ("red bag waste") off-site for incineration. Regulated medical waste presents human health hazards such as dioxin and is costly. Providing training on what constitutes red bag waste is key. By definition (RCRA Title 42 Chapter 82 Subchapter X Sec 6992a), medical waste includes:

(1) Cultures and stocks of infectious agents and associated biologicals, including cultures from medical and pathological laboratories, cultures and stocks of infectious

agents from research and industrial laboratories, wastes from the production of biologicals, discarded live and attenuated vaccines, and culture dishes and devices used to transfer, inoculate, and mix cultures.

(2) Pathological wastes, including tissues, organs, and body parts that are removed during surgery or autopsy.

(3) Waste human blood and products of blood, including serum, plasma, and other blood components.

(4) Sharps that have been used in patient care or in medical, research, or industrial laboratories, including hypodermic needles, syringes, pasteur pipettes, broken glass, and scalpel blades.

(5) Contaminated animal carcasses, body parts, and bedding of animals that were exposed to infectious agents during research, production of biologicals, or testing of pharmaceuticals.

(6) Wastes from surgery or autopsy that were in contact with infectious agents, including soiled dressings, sponges, drapes, lavage tubes, drainage sets, under pads, and surgical gloves.

(7) Laboratory wastes from medical, pathological, pharmaceutical, or other research, commercial, or industrial laboratories that were in contact with infectious agents, including slides and cover slips, disposable gloves, laboratory coats, and aprons.

(8) Dialysis wastes that were in contact with the blood of patients undergoing hemodialysis, including contaminated disposable equipment and supplies such as tubing, filters, disposable sheets, towels, gloves, aprons, and laboratory coats.

(9) Discarded medical equipment and parts that were in contact with infectious agents.

(10) Biological waste and discarded materials contaminated with blood, excretion, excudates or secretion from human beings or animals, who are isolated to protect others from communicable diseases.

Persistent Bioaccumulative Toxins (PBTs)

The Environmental Protection Agency (EPA) designated 12 chemicals as PBTs. PBTs are highly toxic carcinogens that can adversely impact the nervous system; cause reproductive and developmental problems; and cause genetic defects in small children, fetuses, and women in their child bearing years. PBTs do not degrade easily in the environment, can be transported long distances in the environment, and build up in the food chain over time.

Mercury is the PBT most commonly found in various hospital waste streams. Dioxins from the combustion of polyvinyl chloride (PVC) found in red bag waste are a second common hospital-related PBT. "Doing no harm" to human health is a hospital mission. Given the potential impacts of PBTs on human health and the environment, hospitals should strongly consider including these areas in planning and implementing an EMS.

Mercury

Mercury is probably the most common PBT in hospitals. Ten to twenty percent of mercury released to the environment nationwide comes from the health care industry; in fact, medical waste incinerators are the fourth-largest point source. Many local wastewater treatment plants have identified hospitals as industrial pollution sources and have imposed strict wastewater limits for mercury (hospitals are known to contribute 4-5 percent of the total wastewater mercury load). Mercury releases impact human health as well as the environment. In a survey conducted by the National Institute for Occupational Safety and Health, researchers estimated that 70,000 American workers are potentially exposed to mercury vapors on the job, including nurses, lab technicians, and others working in health care facilities. In addition, families of these workers were identified to be at risk of exposure from mercury contaminated work clothes brought home by workers. Identifying starting points for mercury reduction is easy. The

California Department of Health Services found that sphygmomanometers and gastroenterology accounted for 89 percent of the mercury in seven surveyed hospitals. When attempting to identify sources of mercury in your facility, start with items your purchase. Also consider joining voluntary programs. Over 240 hospitals nation-wide have already taken the "Hospitals for a Healthy Environment Pledge" at www.h2e-online.org. Hospitals are committing to becoming mercury free for several reasons including an ethical obligation to protect human health and the environment consistent with the healthcare mission; regulatory requirements; and voluntary agreements between the U.S. EPA and the American Hospitals Association (AHA).

Sphygmomanometers

Each mercury sphygmomanometers (sphygs) contains between 70 to 90 grams of mercury. Coupled with the fact that most sphygs are located in patient rooms, waiting areas, triage centers, and offices and the potential for patient or health care worker exposure to mercury is high, particularly through breakage of these devices. Cleanup costs associated with a mercury sphyg spill cleanup can range from $600 to over $10,000. The accuracy of readings from mercury-based sphygs is also in question. A recent study concluded that "the majority of the mercury sphygs…had serious problems which would give rise to major errors in blood pressure measurement." Many of these error readings result from lack of proper equipment maintenance and training.

Gastroenterology

Various tubes used to clear the gastrointestinal passages, such as Cantor tubes, Blackmore tubes, bougie tubes, and Miller-Abbot tubes accounted for the second largest volume of mercury in the hospitals inventoried in California. A single set of bougie tubes can contain up to 454 grams of mercury. Internal breakage can occur. FDA knows of over 58 incidents reported from 1991 to 2000 in which such mercury-containing tubes broke inside patients, releasing mercury internally.

The good news is that non-mercury substitutes are available for all of these tubes. Some substitutes can be weighted with air, water, or mercury while others are pre-weighted with tungsten. Because the mercury in GI tubes functions as a weight, rather

than a measurement device, the performance of alternatives is less questionable, and tungsten-weighted alternatives have the advantage of being opaque in X-rays, allowing detection of the dilator as it moves through the body.

Thermometry

Although fever and lab thermometers accounted for less than 1 percent of the mercury sources identified at the seven Californian facilities audited, they are important sources of mercury contamination of non-hazardous waste streams because they are often disposed of improperly in red bag waste which is incinerated, releasing mercury into the air.

Non-Clinical Mercury

Non-clinical mercury was generally found in sphyg repair kits as elemental mercury and in barometers, which contain around 800 grams of mercury. The elimination of mercury sphygs from a hospital makes the mercury in sphyg repair kit obsolete, potentially reducing a facility's non-clinical mercury load by approximately 40 percent. Additionally, because aneroid units often do not require calibration using a mercury barometer, the barometer can usually be eliminated. If other devices require calibration, consider replacing the mercury barometer with a 1-millibar precision aneroid (these can cost less than $250). Another option is to simply call the local airport or weather station for a mercury column reading.

There are many viable mercury-free products for hospitals pursuing a mercury-free environment. Other common sources of mercury can be found at the end of this chapter. The Sustainable Hospitals web site (www.sustainablehospitals.org) is perhaps the most comprehensive resource available for finding alternatives. The following case study demonstrates the value of mercury-free alternatives.

Mercury Spill Case Study

Source: Northwest Guide to Pollution Prevention by the Healthcare Sector.

On March 6, 2001, a mercury barometer used to calibrate instruments fell and broke in a 60 square foot office in a Medical Center. An emergency call was placed and personnel arrived on the scene to evaluate, secure and clean up the spill.

In the early afternoon, a Manager in the Department overheard that the mercury spill occurred in a carpeted area. The Manager called the Safety Officer and they both arrived on the scene. Using flashlights they found that there still was mercury on the top surface of the carpet and under the mercury vacuum on the shelf of the spill cart. They asked the staff working in the office to leave and secured the area. Staff were again dispatched to clean the cart shelf area.

An environmental cleanup company arrived and was eventually required to complete the cleanup. Vapor monitoring was done in the office. The portion of contaminated carpet was removed and additional mercury was found below on the substrate. The office was sealed and not reopened until the following day when further air monitoring was done.

On March 7, cleanup personnel returned to the spill site and conducted further air monitoring. The air vapor levels were well within safe ranges and the office was returned to service. Cleanup personnel returned on March 8 to the Spill Cart Storage Room to decontaminate the spill cart. During cleanup, air vapor levels exceeded safe levels. Once all visible mercury was removed, vapor levels began to diminish. The Spill Cart Storage Room was shut down for further monitoring the next day. On March 9, air vapor levels in the Room and the cart had returned to safe levels. Both were deemed operational at that time. The following are the costs associated with the mitigation of the spilled mercury in this 60 square foot office area.

Outside Vendor Cleanup Company – Time, Materials and Labor: $ 4,094.00

Replacement of Mercury Spill Vacuum: $ 3,200.00

Medical Follow up for Hospital Staff: $260.00

Mercury Disposal Costs: $1,600.00

Labor Hours Cost for Hospital Personnel Involved Est: $ 1,000.00

Total Costs for Spill Mitigation: $ 10,054.00

Lessons Learned

Source Reduction Opportunities for Mercury

Material Substitution

Eliminate, reduce, or recycle mercury containing products or waste wherever possible. You may choose to accomplish this by establishing a mercury environmental management program (described later) in your EMS.

- Conduct an inventory/preliminary assessment of mercury in equipment, materials (also chemicals and pharmaceuticals), in storage, and in waste streams. Be sure to look at cleaning supplies for mercury-content.
- Gather life-cycle cost of purchasing/using mercury-containing products versus mercury-free products. Consider potential risk of mercury spills and regulatory fines/penalties associated with unintentional releases.
- Switch to mercury-free products (e.g., thermometers, blood pressure cuffs, lab reagents). This may require establishing an environmentally preferable purchasing procedure as part of your EMS and communicating with the vendor. The purchase of mercury-free products meets this definition. Replacing mercury-formalin tissue fixatives with zinc-formalin fixatives is one example of EPP. Zinc fixatives are substitutes and can reduce or eliminate mercury chloride precipitates that require costly hazardous waste disposal.
- Segregate mercury-containing products before they get into incinerator waste stream (conduct training for proper disposal).
- Use T8 fluorescent lighting. T8 lighting are more energy efficient than incandescent of T12 bulbs.
- Eliminate purchase of mercury-containing products through environmentally preferable purchasing and purchase contracts with vendors/suppliers. Create and enforce agreements with vendors to supply only mercury-free products.

Communicating and involving employees in mercury elimination is absolutely critical to success. Here are some options.

- Include articles devoted to mercury reduction, handling, and proper disposal in staff newsletters.

- Include specific information about the proper handling of mercury in new-employee orientation and "Right-to-Know" training.
- Ensure that all personnel—including temporary workers—are familiar with the facility's mercury handling procedures and protocols to prevent mercury from being disposed of in sharps containers, red bags, or solid waste containers.
- Include information about waste reduction and pollution prevention in in-service training sessions.
- Encourage personnel to be label readers.
- Place placard or labels on or above red bags, sharps containers, and solid waste containers that state "No Mercury."
- Make sure you have mercury spill kits available in all labs, nursing stations, ICU/ER/Surgery rooms, patient rooms and storage/maintenance facilities (Train on proper usage of the kits).

Recycling Opportunities for Mercury

Mercury recyclers may provide airtight, steel containers that the facility can use for collecting and shipping waste without additional packaging. Training, worker understanding and involvement is key in successful mercury handling and reduction. At one hospital, a worker reported that broken thermometers are sharp and disposed of them in "sharps" containers used for waste hypodermic needles. In other instances, workers reported throwing away materials used to clean up mercury spills in infectious "red bag" waste, bound for incineration. The contents of these containers were later incinerated, resulting in an otherwise preventable release of mercury to the environment.

Visit Health Care Without Harm's website at www.noharm.org and investigate the "Mercury Free Medicine Campaign" supported by the National Wildlife Federation. This program has led hundreds of American hospitals to take a pledge to eventually eliminate all mercury within their facility. Look for the many valuable resources on mercury equipment identification and elimination at this website.

Mercury Success Story

Newton Wellesly Hospital in Massachusetts significantly reduced its use of mercury compounds by identifying mercury-containing compounds in use and requiring department managers using these products to develop a time frame for their elimination. Where elimination is not possible, the manager must present an acceptable rationale for to the hospital safety committee. The safety committee in turn is required to maintain a readily retrievable log of mercury-containing products and processes in use, the rationale for continued use, and a time frame for the reconsideration of available alternatives.

Polyvinyl Chloride (PVC) and Dioxin

Polyvinyl chloride is a commonly used polymer in the production of plastic hospital products because of its low cost, flexibility, and optical properties. Twenty-five percent of all health care products such as IV bags, blood bags, and tubing are made with PVC. Other PVC hospital products include: basins, hemodialysis equipment, patient identification bracelets, bedpans, inflatable splints, respiratory therapy products, stationary supplies, catheters, lab equipment, drip chambers, medical gloves, thermal blankets, enteral feeding devices, and packaging. Hospitals also have basic construction materials and furnishings such as water pipes and wall coverings that may contain PVC.

When burned, PVC releases dioxin, a PBT and probable EPA carcinogen. Hospital PVC incineration accounts for nearly half of all dioxin released into the environment in the United States. This is almost completely avoidable considering that only 1-2% of a hospital's waste stream needs incineration. The first step a hospital can take is to gather information through audits and letters to vendors to find out what products contain PVC. Then, identify alternatives and develop and implement a PVC reduction plan as part of your EMS.

The reduction of PVC's can be driven based on the potential for patient exposure to DEHP (a softener added to PVC plastics); potential for the PVC product to be incinerated upon disposal; volume of PVC use; and availability of substitute products. In establishing an organization-wide PVC reduction plan make sure to include the following priorities.

- Target disposable PVC health care products especially within neonatal intensive care units, maternity departments, and pediatrics.
- Phase out the purchase of PVC-containing office supplies, furnishings, furniture products, and construction products. Specify PVC-free purchases.

Polyvinyl Chloride (PVC) Products in Hospitals

Disposable Health Care Products
Blood Products and Transfusions: apheresis circuits, blood bags and tubing, extracorporeal membrane oxygenation ciruits
Collection of Bodily Fluids: dialysis, peritoneal: drainage bags, urinary collection bags, urological catheters, and irrigation sets, wound drainage systems
Enteral Feeding Products: enteral feeding sets, nasogastric tubes, tubing for breast pumps
Gloves
Intravenous (IV) Therapy Products: catheters, solution bags, tubing
Kidney (Renal Disease) Therapy Products: hemodialysis: blood lines and catheters, peritoneal dialysis
Packaging, Medical Products: film wrap, thermoformed trays for admission and diagnostic kits, and medical devices
Patient Products: bedpans, cold and heat packs and heating pads, inflatable splints and injury support packs, patient ID cards and bracelets, sequential compression devices
Respiratory Therapy Products: aerosol and oxygen masks, tents, and tubing, endotracheal and tracheostomy tubes, humidifiers, sterile water bags and tubing, nasal cannulas and catheters, resuscitator bags, suction catheters.
Office Supplies: notebook binders, plastic dividers in patient charts
Durable Medical Products: testing and diagnostic equipment, including instrument housings
Furniture Products and Furnishings: bed casters, rails and wheels, floor coverings, furniture upholstery, inflatable mattresses and pads, mattress covers, pillowcase covers, shower curtains, thermal blankets, wallpaper, window blinds and shades
Construction Products: doors, electrical wire sheathing, water and vent pipes, roofing membranes, and windows

Polychlorinated Biphenyls (PCB)

PCBs do not break down in the environment and can build up in the food chain. They are generally found as oily liquids or solids that are colorless to light yellow. They have no smell or taste and can exist as a vapor in air and soil and as a liquid in water.

PCBs have been used in many industrial applications because of their insulating properties, non-flammability, and chemical stability. PCB applications include electrical capacitors, transformers, surface coatings, inks, adhesives, flame retardants, pesticide extenders, heat transfer systems, fluorescent lamp ballasts, television sets, rubber products, pigments, and carbonless copy paper. In addition, PCB's can also be found in hospitals in lab samples, microscopy fluids, standards, electrical equipment, and hydraulic systems.

Identify materials containing PCB's in your hospital. Take special precautions to segregate these materials from the other waste streams. It is imperative that PCB's are not disposed of by incineration, as this process causes the release of dioxins into the air. For more information on the identification, regulation, and disposal of PCB's, please visit the EPA's PCB Home Page at www.epa.gov/opptintr/pcb.

Common Areas for Hospital Pollution Prevention

Energy Efficiency

Health care is one of the most energy intensive industries in the United States. Hospitals run continuously and certain uses such as diagnostic equipment, large air handling systems, and technical equipment can be particularly energy-intensive. Health care facilities average 228 kBtu energy usage per square foot per year, more than twice the energy per square foot as typical office space. Providing education and incentives for employees to do little things such as turning off computers/monitors, personal heaters and unused lights at night can really add up in a hospital.

In the long-term picture, the key to gaining control over energy use is in looking at your facility's historical electric, gas, oil and steam use, as well as your peak demand periods. Convert energy usage to a standard measure, such as Btu per square foot. Where possible, use such measures to compare your energy performance against other hospitals and institutions. This can highlight higher-than-expected usage and allow you

to take corrective action. A further reason for facility managers to understand energy use is to guard against major cost swings due to variations in electric and gas rates. Emerging utility deregulation is creating opportunities to purchase electricity and gas from the lowest cost supplier. Energy managers who know the most about their energy use will be able to leverage that knowledge to obtain the best energy contracts.

Health care organizations have the opportunity to increase their attention to energy conservation as part of their EMS. The US EPA has many programs that foster this type of activity, providing incentives, rewards, and technical assistance. US EPA's Green Lights program, Energy Star, and Climate Neutral are programs health care organizations can adopt and benefit from. Health care organizations can become prudent consumers of energy and take advantage of opportunities to invest in renewable energy, thus reducing the adverse impacts on the environment and health. More than 875 hospitals and health systems across the country have partnered with EPA in an effort to reduce hospitals mounting energy costs while also preventing pollution. Energy Star Buildings and Green Lights healthcare Partners have experienced an average annual savings of $0.63 per square foot. To learn more about how your healthcare organization can benefit from the Energy Star and Green Lights Partnership visit the Web site at www.epa.gov/buildings or call toll-free Energy Star Hotline at 1-888-Star-Yes.

Energy Efficiency Success Story

Mercy Hospital in Pittsburgh, Pennsylvania participated in Energy Star and instituted a comprehensive energy plan that resulted in operational and cost savings of more than $1 million. Mercy accomplished this by retrofitting lighting to high efficiency T8 lamps and electronic ballasts, expanding its energy management system to allow for better monitoring and control, installing variable speed drives on chilled water pumps, and replacing chillers and cooling towers with new high efficiency equipment.

Pharmacy

US EPA states that pharmaceutical products do not become waste until the decision has been made to discard them. If the damaged or outdated products are

returned to the manufacturer, distributor, or third party processors with the intent to receive, reclaim, or destroy, they are regarded as products (not waste) at the time they are shipped. The only requirement for shipping becomes proper DOT labeling.

Source Reduction Opportunities

Open formularies make monitoring patient drug use more difficult and can significantly contribute to the volume of drugs that must be disposed. Open formularies allow providers to dispense samples to patients. This dispensing practice encourages the development of secondary storage areas. Once established, secondary storage areas and their environments cannot be controlled. When drugs are improperly stored (e.g. improper cooling requirements), they may become obsolete and require disposal, increasing disposal costs.

- Monitor outside drug sources.

  Medical providers (who may have off-site offices) with hospital privileges accumulate samples that may become a disposal problem for pharmacies. Typically, pharmacies dispose of these drugs gratuitously for the provider.
- Track and reduce the distribution of drugs samples.

Hazardous Wastes

Inventory Control for Hazardous Wastes

Effectively managing inventory provides the next best opportunity to reduce hazardous waste generation. A good inventory control program attempts the following.

- Adopt a first-in, first-out policy-chemicals. For example, purchased first should be used first. Reduce high volume chemical inventories to an ideal supply level of four weeks or less.
- Central distribution. For inventory control purposes, chemicals should be delivered to a central location at the hospital (one common dock area) and distributed throughout the facility by a designated individual. Ideally, this individual would be your Shipper/Receiver or a Central Supply/Stores staff member.

- Chemical standardization . This promotes sharing of chemicals between common users.
- Developing and implementing a program involving the reuse of unwanted, but usable chemicals. A computerized, running inventory of unused reagent chemicals for reuse in other departments is helpful.
- Tracking waste generation.
    - Develop data (chemical inventories) by user groups identifying high volume user and generators.
    - Locate caches of unused reagents/chemicals and determine why they are accumulating.
    - Monitor reagent/chemicals half-life and expiration dates.
- Ensuring that the identity of all chemicals is clearly marked on all containers. It is illegal to ship unused reagent chemicals, containers, and solution mixtures and unidentified wastes for disposal without proper labeling.

Secondary Containment for Hazardous Wastes

Secondary containment collects leaks and spills. It protects your property, water, resources and employees from hazardous waste spills. It's a minimal investment compared to the possible clean up cost associated with one spill or accident.

Use secondary containment systems in satellite accumulation areas and final waste accumulation areas. Secondary containment should:

- Ensure that the storage area keeps out rain, snow and standing water.
- Prevent water, such as storm water from a parking lot, from entering the containment system. Careful layout, sloping or elevating the containment area above grade usually works.
- Ensure that the stored wastes cannot penetrate the base or floor of the system. Sealed concrete and impervious plastic may work well while asphalt generally does not. Avoid cracks or unsealed joints.
- Make sure the system can hold the entire volume of the largest container.

Cleaning and Common Laboratory Chemicals

Source Reduction Opportunities

Material Substitution

Environmentally preferable purchasing (EPP) of cleaning supplies and other common chemicals can positively impact the health of your staff, patients, and visitors. Many cleaning chemicals are flammable and contain chlorinated solvents. Thus, your choice of chemicals may also provide an opportunity for reducing and eliminating hazardous wastes. There are many potential advantages of establishing an EPP program for your chemicals including the following.

- Creation of a safer environment
- Continued cleaning effectiveness. Many of the new-generation environmentally friendly cleaning products are high-level disinfectants and include the same infection control/sterilization capabilities that the old chemicals possessed.
- Reduced concerns about potential chemical incompatibility.
- Environmentally friendly cleaning attributes including biodegradability and reduced toxicity.
- Potentially fewer cleaning products.
- Potential to streamline purchasing with fewer products.
- Reduce the chance for exposure to dangerous chemicals.
- Environmental stewardship – "Lead the Charge."

Some people may oppose EPP for many of the same reasons they might oppose an EMS.

- It is new – people may not want to cooperate
- It is different – people are unsure of different ideas
- Change is often challenging and can be time consuming
- Training will likely be necessary

EPP helps you evaluate the use of less hazardous materials and cleaning agents in non-critical requirements. Here are some examples and tips for chemical change-out in a hospital environment.

- Using simple alcohols and ketones instead of petroleum hydrocarbons. Toluene and xylene are examples of compounds to replace. Terpene-based solvents and naphtha isoparaffinic hydrocarbons may be substituted for xylenes used in slide cleaning in some applications. Citrus-based alternatives may reduce worker exposure but may produce hazardous waste due to possible flashpoints less than 140 degrees Fahrenheit.
- Evaluate physical cleaning methods that may replace and reduce chemical cleaning requirements.
- Evaluate the use of sonic or stream cleaning instead of alcohol-based disinfectants or other forms of chemical sterilization.
- Evaluate specialty detergents, potassium hydroxide, or sonic baths to replace chromic and sulfuric acid for cleaning glassware. Sodium or potassium dichromate dissolves in sulfuric acid and chromic acid cleaning solutions are common methods of cleaning glassware. However there are alternative cleaning agents that have proven effective and less hazardous.
- Use biodegradable or aqueous detergents where possible. In some cases, powerful cleansers are still essential.

Focus on Ethylene Oxide and Glutaraldehyde

Hospitals typically use ethylene oxide (EtO) to sterilize moisture and heat sensitive instruments and glutaraldehyde as a high-level disinfectant. EtO poses several health hazards that require special handling and disposal of the chemical and training in its use. The National Toxicology Program has identified ethylene oxide as a known human carcinogen. Some of the side effects of EtO are nausea, vomiting, and neurological disorders from inhalation, eye, skin, and lung irritation when in solution, and may also cause damage to the central nervous system, liver, and kidneys. A small selection of hydrogen peroxide and peracetic acid based sterilants can be used to replace EtO for many applications throughout your hospital.

Hospital employees who commonly use glutaraldehyde range from members of gastroenterology and cardiology departments to research technicians, researchers, and pharmacy personnel who prepare alkaline tissue fixative solutions in laboratories.

Symptoms from glutaraldehyde exposure include asthma, burning eyes, headaches, hives, nausea, nose bleed, nose irritation, rashes, staining of the hands, and throat and lung irritation. There are cost-competitive non-glutaraldehyde alternative that exist and meet infection control standards and reduce risks to patient, visitor, and employee health.

Train people to check labels for the ingredients. Mercury often can show up in cleaning chemicals at less than 1% content, below the limit which requires the chemical manufacturer to disclose the content, but high enough to cause water discharge violations. Consequentially, you may need to contact chemical manufacturer for a chemical analysis, particularly if you are attempting to eliminate all mercury or have a mercury problem. The following attributes should be present in some verifiable or demonstrable degree in an offered product. Suppliers are required to provide a Material Safety Data Sheet (MSDS), equivalent information, and/or any additional information upon request.

The following are EPP criteria you may use to evaluate cleaning and other chemicals. Failure of a product to meet any of the criteria listed below should trigger search for a more environmentally friendly product.

Carcinogen: Try to eliminate the use of products containing known and probable carcinogens. The following organizations classify known or probable carcinogens.

- American Conference of Governmental Industrial Hygienists (ACGIH);
- International Agency for Research on Cancer (IARC);
- National Institute of Occupational Health and Safety (NIOSH);
- National Toxicology Program (NTP); and,
- Occupational Health and Safety Organization (OSHA).

Flammability/Flash Point: Products that do not ignite easily are favored.

Corrosiveness (pH): Products that have a pH closer to neutral are favored.

Chronic Health Risks: Products that pose no potential for chronic health risks are favored.

Skin/Eye Irritant: Products that are less irritating to the skin and eyes are favored.

Volatile Organic Compound (VOC) Content: Products with the lowest VOC levels possible are favored. Most desirable are products that do not contain VOC's in concentrations that exceed 10% of the weight of the product.

Ozone-Depleting Compounds: Products that do not contain ozone-depleting compounds are favored.

Biodegradability: Products that are partially or completely biodegradable are favored.

Product Packaging: Products that are packaged in recyclable or reusable containers (such as use of refillable product distribution devices and/or concentrates) and containers made with a percentage of post-consumer recycled materials are favored. Additionally, products that use no, or only a minimal amount of, polypropylene and/or polystyrene ("Styrofoam") packaging are favored.

Energy Needs: Products that work effectively in cold water, which decreases the amount of energy consumption necessary, are favored.

No Sealed Aerosol Spray Cans: All chemical cleaning products must be available in either a liquid form or manual pump action sprays and/or concentrates that can be dispensed into pump bottles for use.

Dyes and Fragrances: Products that do not contain dyes or fragrances are favored.

Products should be tested for efficacy. A chemical cleaning or recycled content product that meets the desirable attributes still may be deemed ineffective for its intended purpose(s) after testing.

Solvents

Solvents are predominantly a waste of lab waste streams. They are used for fixation and preservation of specimens in histology and pathology and for extractions in laboratories. Halogenated solvents are generally more toxic and persistent than nonhalogenated solvents. Halogenated compounds used in hospitals include methylene chloride, chloroform, tetrachloroethylene, chlorobenzene, trichloroethylene, 1,1,1-trichloroethane, and refrigerants. Source reduction is the best option for solvents, but if use of a solvent can't be eliminated, work practice modification may be the next best bet.

- If using solvent, conduct initial cleaning with used solvent and then fresh solvent for the final cleaning. This is countercurrent cleaning and decreases the amount of solvent used. When solvent used for the initial cleaning step becomes too

dirty, eliminate it and replace with solvent from the second cleaning step and so on.

- Using a wide variety of solvents means there will be a wide variety of waste streams to manage. Investigate the possibility of using one type of solvent for equipment and other cleaning. By switching to one type of solvent, it may be cost-effective to have onsite distillation.
- Before placing lab ware in autoclaves or other cleaning equipment, drain chemicals out of containers and collect in proper disposal receptacles. This can significantly reduce the amount of contaminate wastewater entering the POTW system.

Alternative Mopping Techniques

Many floor cleaners used in hospitals contain harsh chemicals such as quaternary ammonium chlorides and butoxyethanol, which can be harmful to human health and the environment. To reduce risk of cross-contamination for patients, conventional mopping techniques require janitors to change the cleaning solution after mopping every two or three rooms. This means that cleaning solutions are constantly being disposed of and replenished. There are three drivers for changing the way custodial staff maintain the floors in patient care areas: to reduce chemical and water use and disposal, to reduce cleaning times for patient rooms, and to reduce custodial staff injuries and workman's compensation claims from the repeated motions of mopping and wringing.

Microfiber mop heads, a relatively recent innovation, may help. These mop heads weigh approximately 5 pounds less than conventional loop mops and are changed after each room. This benefits the custodial staff by reducing the effort of wringing a conventional mop and not having to change the water between rooms (provided the mop head is not put back in the water once it's been used in a room).

Pilot test results indicate a 60 percent lifetime cost savings for mops, a 95 percent reduction in chemical costs associated with mopping tasks, and a daily 20 percent labor savings associated with mopping. There were only a few limitations to this option. The medical center found that it was best to use conventional mops in areas contaminated with an extraordinary amount of blood or other bodily fluid. It was also found that microfiber mops are not as effective in greasy, high-traffic kitchen areas. The microfiber

mop heads can also not be laundered in industrial washers and dryers. Instead a standard commercial washer and dryer with controlled heat settings and standard laundry detergent is used.

Cleaning Products Success Story

The City of Santa Monica, California's green cleaning product purchases have eliminated the purchase of 3,200 pounds of hazardous materials annually. This translates into a savings of approximately 5 percent of annual spending on cleaning products when compared with the traditional products it was purchasing.

Chemotherapy and Antineoplastic Chemicals

Chemotherapy and antineoplastic chemicals are generally handled through a central clinical laboratory or pharmacy. Administrative controls represent the best alternative to reducing these wastes.

Source Reduction Opportunities

- Minimize the cleaning frequency and volume of gauze materials used for the compounding hood. Cleaning frequency depends on drug handling volume and the amount of spillage that occurs in the hood. Proper handling practices and techniques should be emphasized to minimize hood cleaning frequency and waste generation. These teaching points may be added to existing OSHA training conducted for the hoods.
- Purchase drug volumes according to need. Over-purchasing results in generation of outdated materials that must be disposed. Reducing waste may be accomplished by computing daily compounding requirements of each drug and ordering appropriately sized containers. Work with supplier to return outdated drugs.
- Centralize the location of chemotherapy compounding areas.

Formaldehyde

Source Reduction Opportunities

Material Substitution

Formalin (formaldehyde and water) is used to disinfect dialysis machines. Check with your machine vendors to determine if bleach, paracetic acid, or other disinfectants can be used instead of formalin. Carefully evaluate all substitutes for cleaning effectiveness and comply with all machine manufacture requirements.

If formaldehyde must be used, use the smallest sized container of formaldehyde possible. Provide training to staff on the importance of this in reducing waste and costs.

Procedure Modifications

Determine the minimum effective cleaning formalin concentration. Effective formalin concentration for disinfecting and cleaning machines and disinfecting dialyzers are in the Centers for Disease Control Guidelines. Formalin concentrations used to disinfect dialysis machines vary among machines and hospitals. Formalin is typically purchased in concentrations that range from 10 to 37 percent. Many machines will dilute the 37 percent formalin to a 10:1 ratio to achieve a 4 percent **disinfecting** concentration. Formalin concentrations of 2 percent are not recognized as effective disinfectants.

However, some machines will requires mixing of formaldehyde and water to produce formalin that is poured into machines. These machines don't internally dilute formalin. Therefore, the effective formalin concentration (4 percent) should be measured accurately and maintained consistently. Using formalin concentrations greater than 4 percent for disinfecting machines may generate unnecessary wastes.

Dialyzers

Formalin usage may be reduced in dialyzers. The use of special incubators to heat dialyzers in 1.0 percent formalin solution at 40° C for 24 hours may be effective alternative to using 4 percent formalin at room temperature for 24 hours[5].

Recycling (Reuse) Opportunities for formaldehyde

In autopsy and pathology laboratories, it may be possible to reuse formaldehyde in specimen preservation. These solutions retain their desired properties for periods far longer than the usual holding times for specimens. In addition, the desired preservation properties may be effective at concentrations less than the standard 10 percent.

Radiation Therapy

Radioactive wastes are generated in nuclear medicine and clinical testing laboratory departments. Radioactive wastes cannot be treated or neutralized. Radioactive wastes are typically retained on site (in areas 100-200 square meters in size) until their half-life is spent and they are no longer considered hazardous. These low level

radioactive wastes need to be segregated and properly labeled as isotopes, form, volume, laboratory origin, activity and chemical composition. Proper labeling and handling are legally required and make waste management decisions easier. Radioactive and other hazardous wastes should not be mixed. Try to use suppliers that will accept return of isotope containers.

Source Reduction Opportunity

- Evaluate processes for substitution of long-lived isotopes with short-lived isotopes. For example, use iridium-192 or cesium-137 in place of radium-226.

Radiology

Full-service hospitals generally have a radiology department. The main waste stream is water containing used photographic developing solutions (fixer and developer) and silver. Silver-containing effluent from the fixer solution is passed through a steel wool filter or otherwise treated to recover this precious metal.

Source Reduction Opportunities

- Store materials properly. Many chemicals are sensitive to temperature and light. Chemical containers list the recommended storage conditions. Meeting the recommended conditions will increase their shelf life.
- Extend processing bath life. Techniques for extending bath life include: 1) adding ammonium thiosulfate, which doubles the allowable concentration of silver buildup in the bath; 2) using an acid stop bath prior to the fixing bath; and 3) adding acetic acid to the fixing bath as needed to keep the pH low. Accurately adding and monitoring chemical replenishment of process baths will cut down chemical wastage.
- Use countercurrent washing to replace the commonly used parallel tank system. This can reduce the amount of wastewater generated. In countercurrent washing, water from previous rinsing is used in the initial film-washing stage. Fresh water enters only at the final stage, at which point much of the contamination has already been rinsed off the film.

- Implement dry laser film processing. This process reduces the chemicals that are manually poured into the machine and does not need to be connected to the sanitary sewer for chemical discharge.

Recycling Opportunities for Radiology

There are four major waste streams associated with electrolytic image processing at hospital radiology department that must be managed properly. They are:

- Silver that is recovered from recycling units. This silver waste is not a hazardous waste.
- Discharge wastewater. The wastewater may contain silver. The wastewater is hazardous if its concentration is greater than 5ppm.
- Spent fixer is hazardous if its silver concentration is greater than 5ppm.
- Discard X-ray film has recoverable amount of silver that is typically removed by a recycler for processing. The reclaimed silver can be used in other industrial or commercial applications. If the silver is removed, the remaining X-ray film is recyclable polyester.

The two most common methods of recovering silver are metallic replacement and electrolytic replacement. Metallic replacement involves ion exchange between silver and another metal. The other metal is usually iron (mesh) or steel wool. Electrolytic replacement involves the accumulation of silver on a negative cathode. The silver is reclaimed from a 5-10 percent fixer solution.

Xylene

Source Reduction Opportunities

Material Substitution

Xylene is used in processors, stainers, and as a cleaning agent that removes paraffin from the tissue. There are alternative chemicals that have been used to replace xylene in the stainers.

Carefully evaluate citrus-based substitutes. Citrus-based alternatives may reduce worker exposure but may produce a hazardous waste due to flashpoint less than 140°F.

These citrus-based solvents may process samples slower than xylene and will require temperature and time modifications. Generally, these products are effective on samples in the micrometer range. However, thicker samples may be difficult or impossible to process. Evaluate hazardous waste and quality issues before using xylene alternatives.

Procedure Modification

Do not mix wastes unnecessarily. Sometime wastes are mixed without respect to characteristic and compatibility at the point of generation. In one hospital, five 16-gallon drums of formalin (fixation), alcohols (dehydrators), xylene (processors), chronic acid (glass cleaner), paraffin wax, and water were mixed. In this case, the hospital reduced 75 percent of its RCRA hazardous waste by **not** mixing formalin waste with alcohol waste.

Inventory Control

Mounting chemicals are used to stabilize the sample on the slide and contain polymers and solvents such as toluene and xylene. Control the inventories of these chemicals because they have limited shelf lives.

Evaluate routine laboratory processes or tests such as fixation and extraction to determine if quantities of reagents are reducible. The evaluation can include using calibrated solvent dispensers and unitized test kits; reducing volumes of reagents; and increasing the use of instrumentation in tests and experiments.

Recycling Opportunities for Xylene

There is significant opportunity to reduce hazardous waste generation in hospital histology laboratories by distilling xylene. You can eliminate hazardous waste that must be manifested except for an extremely small quantity of sludge (still bottoms) from distillation, which is an F003 hazardous waste. Other solvent wastes may not have sufficient generation rates to use distillation. Distillation of xylene will reduce xylene raw material costs. At a minimum:

- Evaluate the quality of distilled xylene. Laboratory personnel and/or chemical review board members should agree on recycled xylene quality.

- Do not mix waste streams because this practice may complicate or negate distillation opportunities.
- Standardize solvent usage if possible.

Check with your local fire marshal and OSHA field office to determine if there are location and safety issues that must be addressed. Fire-rated doors and walls, impermeable floors, designed ventilation, and locations away from patient care areas are some issues that must be addressed.

Fluorescent Lights

Source Reduction Opportunities

To reduce the mercury waste that is generated when lights are disposed, consider:

- Using T8 lamps instead of T-12 lamps.
- Using timed lights or lights with occupancy switches instead of manual switches.
- Implementing EPA's Green Lights Program
- Recycle fluorescent light bulbs

Maintenance Wastes and Recyclables

Aerosols

Aerosols are present in many areas throughout the hospital, but primarily in the facility maintenance areas in health care organizations. Aerosols include adhesive cleaners, electronic solvent cleaners, touch-up paints, and ceiling tile renewers.

Source Reduction Opportunities

Discourage the use of aerosols. If aerosol purchases seem high, investigate which activities use the most and focus reduction efforts on these.

Inventory Control

An inventory control system can assist in reducing waste. Request products from the manufacturer in recyclable non-aerosol pump sprays. Order products according to demand as expired shelf life may require excess inventories to be disposed. Dispense aerosol cans when an empty can is returned. This process should be controlled through one person in one location to prevent unnecessary usage.

Recycling Opportunities

Facilities are available that recycle aerosol containers. If they do not offer pick-up services, see what options are available to send your aerosol containers to them. If you generate enough aerosol container waste, investigate the purchase of an on-site recycling unit.

Batteries

Batteries are used in numerous applications including the following: cameras, pagers, flashlights, exit signs, alarm systems, backup power sources in medical monitors, hearing aids, smoke detectors, glycometers, and many others. Some common varieties of batteries include alkaline magnesium, nickel-cadmium, silver-cadmium mercuric oxide, lithium, and zinc-air. Check your state regulations regarding how to handle these spent batteries, as they often must be considered hazardous waste due to the metal content. In some cases, recycling spent batteries may be possible.

Source Reduction Opportunities

Zinc-air batteries may be used to replace the more hazardous mercuric oxide batteries in some applications. Carefully consider the use of rechargeable batteries. They may not be appropriate in all situations, especially those involving life saving equipment where a partially recharged battery could result in equipment failure and death. While some batteries such as the nickel-cadmium are rechargeable, they, too, will need eventual disposal.

Recycling Opportunities

Contact your commercial hazardous waste provider to find out if they will recycle batteries, and the Hazardous Waste Branch Division of Waste Management at (502) 564-6716 for local office information.

For rechargeable battery recycling visit Rechargeable Battery Recycling Corporation at www.rbrc.org/consumer/uslocate.html to find the rechargeable battery recycling location closest to you or call 1-800-BATTERY. For lithium batteries call Battery Solutions Inc., 38680 Michigan Avenue, Wayne, MI 48184 (313/467-9110). For additional resources on other types of batteries visit Recycler's World at www.recycle.net/battery/index.html.

Laundry and Laundry Detergents

Source Reduction Opportunities

Educate staff to recognize and separate out hazardous materials before doing the laundry. Rags used to clean up hazardous spills are also hazardous waste and need to be disposed of properly. Optimizing the use of laundry chemicals and minimizing accidental spills is achieved through work training, prepackaged laundry chemicals, or the use of automated laundry feed. Laundry chemicals are often supplied in 5-gallon containers; consider receiving chemicals in totes.

Training and Technology Modification

Poor handling of laundry chemicals can lead to accidental spills, underuse, or overuse of chemicals. Under use of laundry chemicals results in poorly cleaned articles that must be cleaned again. The overuse of laundry chemicals unnecessarily increases the volume of chemicals and increase raw material costs.

Optimizing the use of laundry chemicals and minimizing accidental spills is achieved through worker training, prepackaged laundry chemicals, or the use of an automated laundry chemical feed system. While laundries might incur capital costs to install an automated system, the savings from optimal chemical usage and reduction in labor costs may have long-term benefits.

Paints

Source Reduction Opportunities

Material Substitution

Replace oil-based paints with water-based paints in facility maintenance operations to eliminate the use of solvents and thinners as cleaners. Using paints without metal pigments or paints with high solid, low volatile organic compound will also help reduce hazardous waste.

Inventory Control

Controlling inventory is important when trying to reduce waste. Three practices that can help control inventory:

- Adopt first-in, first-out inventory practices for paints to reduce waste associated with expired shelf life.
- Purchase paints only in needed quantities.
- Do not mix more paint than is needed for a painting job.
- Standardize paint colors in the facility.

Training

Over-spray is the paint that does not reach the part or wall. Over-spray creates waste and increases raw materials cost. To reduce over spray:

- Use spray system equipment with high transfer efficiency. High volume low pressure (HVLP) guns provide the highest transfer efficiency. Electrostatic spray guns also improve transfer efficiency.
- Maintain proper pressure as identified in the operator's manual for specified gun systems. Higher pressures contribute to over spray.
- Clean spray gun nozzles.
- Replace damaged nozzles.
- Keep spray gun perpendicular to the surface.
- Maintain a fifty percent overlap of spray pattern.
- Maintain gun distance of six to eight inches from work piece.
- Trigger gun at the beginning and end of each stroke.
- Use heaters to reduce paint viscosity instead of adding thinners.

Recycling

If paint guns are cleaned with solvents, consider investing in a gun cleaner system that re-circulates the solvent. Gun cleaners can save you as much as 30 percent on disposal and raw materials.

Let paint brushes and rollers used with latex or water-based paints stand in a pail of water prior to rinsing. This will help reduce the water consumed when cleaning the brush.

Pesticides and Landscaping

Source Reduction Opportunities

Reduce generation of pesticide waste generated by grounds maintenance activities by:

Reducing pesticide inventories toward a goal of just-in-time.

Reducing pesticide, herbicide and fertilizer quantities

Preparing and using only the required quantities

Using non-chemical pest control methods such as corn meal gluten a natural herbicide

Using dry pesticides that are spread on the ground and watered into the ground. Using this method may eliminate the need for pesticide spraying containers and the resulting contaminated wastewater from clean up.

Use contract services for insect control, rodent control, and lawn maintenance. Waste is managed by the contractor and doesn't impact the hospital's generation rates.

If you have contracted off site landscaping services at your hospital facility, work with your service to eliminate pesticides and herbicides, to use plants that are native to the area and do not have to be watered as often, as well as using mulching mowers to eliminate bagging grass wastes.

Possible Sources of Mercury

Thermometers Body temperature thermometers Clerget Sugar test thermometers Heating and cooling system thermometers Incubator/water bath thermometers Minimum/maximum thermometers National Institute of Standards and Technology calibration thermometers Tapered bulb (armored) thermometers	**Tilt switches** Air flow/fan limit control Building security systems Chest freezer lids Fire alarm box switches Lap top computer screen shut-off Pressure control (mounted on bourdon tube or diaphragm) Silent light switches (single pole and three way) Temperature control
Sphygomanometers	**Gastrointestinal tubes** Cantor tubes Esophageal dialators (bougie tubes) Feeding tubes Miller Abbott tubes
Lamps Fluorescent Germicidal High-intensity discharge (high pressure sodium, mercury vapor, metal halide) Ultraviolet	
Dental amalgam	**Pharmaceutical supplies** Contact lens solutions and other ophthalmic products containing thimerosal, phenylmercuric nitrate Diuretics with mersalyl and mercury salts Early pregnancy tests kits with mercury containing preservatives Merbromin/water solution Nasal spray with thimerosal, phenylmercuric acetate or phenylmercuric nitrate Vaccines with thimerosal (primarily in hemophilus, hepatitis, rabies, tetanus, influenza, diphtheria and pertussis vaccines)
Float control Septic tanks Sump pumps Thermostats (non-digital) Thermostat probes in electrical equipment Reed Relays (low voltage, high precision analytical equip) Plunger or displacement relays (high current/high voltage)	
Thermostat probes Gas Appliances Flame sensors Gas safety valves	**Pressure gauges** Barometers Manometers Vacuum gauges

Chemicals that contain mercury	Phenobarbital reageant
Acetic Acid	Phenol Mercuric Acetate
Alum hematoxylin (Solution A)	Phenytoin reagent
Ammonium reagent/Stone Analysis kit	Positive control kits
Antibody test kits	Potassium hydroxide
Antigens	Pregnancy test kits
Antiserums	Rabbit serum
B5 fixative	Shardin Solution
Buffers	Shigella bacteria
Bleach solutions containing sodium hypochlorite	Sodium hypochlorite
	Stains
Cajal's	Stabilur Tablets
Calibration kits	Standards
Calibrators	Takata's reagent
Camco	Thimerosal
Carbol Gentain violet	Tracer kits
Chloride	Urine analysis reagents
Carnoy-Lebrun solution	Wash solutions
Diluents	Zenker solution
Enzyme Immunoassay test kits	
Enzyme tracers	
Ethanol	
Extraction enzymes	
Fixatives	
Gomori's	
Golgi's	
Gram Iodine	
Helly solution	
Hematology reagents	
Hitergent	
Hormones	
Immunoelectrophoresis reagents	
Immunofixationphoresis reagents	
Immun-sal	
Mercury chloride	
Mercurochrome	
Mercurophyline	
Mercury iodide	
Mercury nitrate	
Mercury sulfate	
Merthiolate	
Million's reagent	
Mucolex	
Negative control kits	
Nessler's solution	
Ohlamache	

Other sources of mercury Devices, such as personal computers that utilize a printed wire board Blood gas analyzer reference electrode (Radiometer brand) Cathode-ray oscilloscope DC watt hour meters (Duncan) Electron microscope (mercury may be used as a damper) Flow meters Generators Hitachi Chem Analyzer reagent Lead analyzer electrode (ESA model 3010B) Sequential Multi-Channel Autoanalyzer (SCMA) AU 2000 Vibration Meters	

Planning and Managing the EMS

Environmental Aspects & Impacts and Determining Significance

Introduction

This section focuses on the performance-based components of the EMS and how they link together. These are the components that most directly drive positive change in actual environmental performance improvement. It all starts with identifying your hospital's environmental issues (termed environmental aspects) with the ultimate goal of determining those aspects that significantly "impact" on the environment. Significant impacts are considered in setting objectives and targets. Operational controls such as work instructions will help minimize the significant impacts and help your organization meet its objectives and targets. Monitoring and measurement asks you to track your progress against both of these.

The end of the section covers topics including training, communication, documentation/document control and other EMS "support" components without which the EMS (or for that matter, any organization) can not fully or effectively function.

Environmental Aspect: "An element of an organization's activities, products or services, that can interact with the environment" (ISO 14001 Standard)

Example: Environmental aspects for landscaping practices may include air emissions natural resource consumption (i.e. water, fuel), chemical usage, and possible chemical spillage.

Environmental Impact: "Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services." (ISO 14001)

Example: The environmental impact(s) associated with landscaping chemical usage may include: air pollution, human health affects, groundwater and/or storm sewer contamination, and flora and fauna (plant and animal) health affects.

Environmental aspects drive the EMS. An EMS encourages healthcare organizations to systematically address the environmental aspects and impacts associated with its activities, products, and services. This is a perfect opportunity for pollution prevention.

Pollution prevention can often eliminate or greatly reduce many environmental aspects. For those aspects that can not be eliminated upfront, other pollution prevention alternatives can be used to manage them in a more environmentally-friendly manner. Environmental aspects can include waste generation, resource utilization and depletion, energy utilization, and noise/light pollution.

Identifying all of your aspects and impacts can be a big job. One manufacturing facility had 550 aspects. Ultimately, this facility determined that 50 of its 550 aspects were 'significant' according to its criteria and eventually set objectives and targets for 10 of its most significant aspects. The key point is that you will have many aspects; but not all of your aspects will be significant and not all significant aspects need to have an objective and target.

The first step in identifying your aspects is setting the scope of your EMS. Do you want to include the whole hospital in the EMS, select hospital buildings on-site or just selected departments? You may wish to implement an EMS in one part of the hospital on a pilot project basis and then take the advantage of "lessons learned" to implementing the EMS hospital-wide. Also, a positive experience on the pilot can build momentum as you approach other departments; conversely, a less-than-positive experience can thwart your efforts as you approach other areas to start the EMS. Next, identify activities and services within the scope of your EMS. These are starting points for the next step: identifying aspects and impacts. Identify aspects and impacts associated with each activity or service. Techniques you may choose to use to identify aspects include process mapping (charting a materials flows from entry into your hospital, through use, and disposal/recycling); interviewing; benchmarking against other hospitals and healthcare organizations; and inspections and audits.

Next, identify the impacts associated with each aspect. Impacts are the changes in the environment that occur as a result of the aspect. Examples of impacts can include increases in ground level ozone (air pollution); degradation of water quality or drinking water supplies; conservation of natural resources (through recycling, for example); and soil pollution (from accidental spills). Ask whether you have control or influence over each aspect. Your hospital's degree of control or influence over different aspects will vary. For example, energy usage is an aspect. Your hospital may not have control over

what kind of fuel your utility burns to provide power, but your hospital does have considerable control over how much energy it uses and requires from its utility.

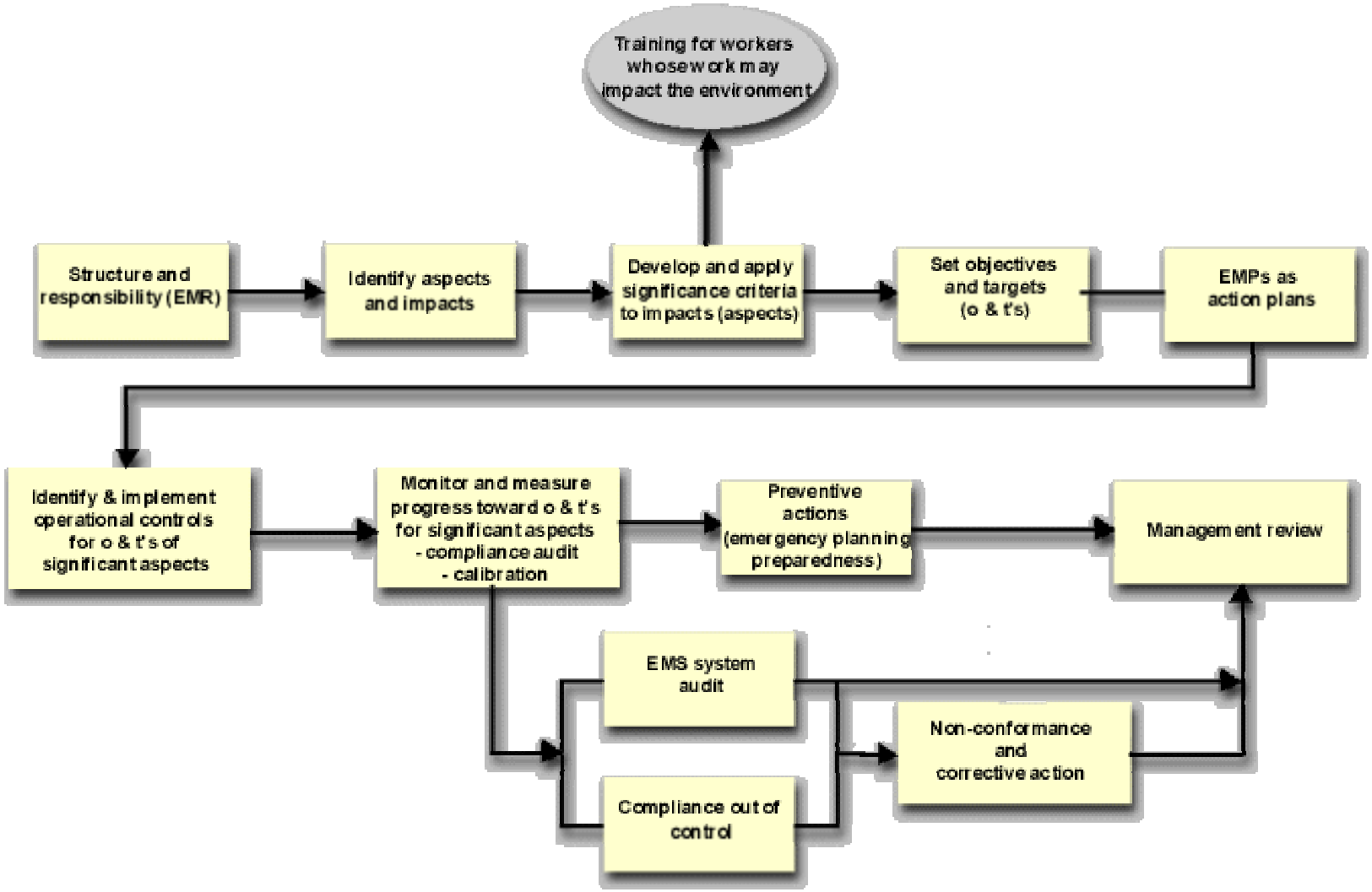

Training for workers whose work may impact the environment
Structure and responsibility (EMR)
Identify aspects and impacts
Develop and apply significance criteria to impacts (aspects)
Set objectives and targets (o & t's)
EMPs as action plans
Identify & implement operational controls for o & t's of significant aspects
Monitor and measure progress toward o & t's for significant aspects - compliance audit - calibration
Preventive actions (emergency planning preparedness)
Management review
EMS system audit
Non-conformance and corrective action
Compliance out of control

Table 1 and Table 2 at the end of this section show example aspects and impacts for a health care facility. Key information to write down includes the following.

1. The name of the activity, product or service with a short description of process in question.
2. The environmental aspect(s) associated with each activity, product, or service.
3. Legal Requirements: Is the environmental aspect(s) of the activity, product or service legislated and/or regulated?
4. Actual/potential impacts associated with each aspect
5. Significance rating. This may be based on the example shown. In the example, frequency, consequence, and degree of control are each independently rated then combined for a Total Significance score. More on determining significance is presented later in this section.

You may find the examples in this manual do not cover all the functions and activities performed at your hospital. Use them as a guide to help you conduct a thorough analysis of the activities within your facility.

You may choose to use environmental regulations as one approach to identifying your aspects and impacts. Be sure, though, not to limit yourself to only regulated aspects and impacts when developing your aspects/impacts inventory. This is an easy trap to fall into. Many environmental managers gained their environmental work experience from a compliance-based perspective and think in media-based terms-air, water, and solid or hazardous waste. This can lead to an emphasis on "end-of-pipe" treatment technologies and missed cost savings opportunities. For example, how much energy and water your hospital uses is not regulated (in most U.S. locations) and would likely not be examined in a compliance-based EMS; however, these areas often present significant cost-savings opportunities.

Roles and Responsibilities in Identifying Aspects and Impacts

When identifying your environmental aspects and impacts you can do it individually or by enlisting the help of your Green Team. Involving your Green Team divides the workload and gives the members more of a hands-on involvement earlier in EMS implementation. You may need to provide aspects/impacts training to the Team and review and monitor the departments' work outcomes to ensure continuity between

the department's lists, but the approach is an effective way to build rapport with department managers and personnel.

Alternatively, you may choose to develop your aspects inventory as an individual. This approach allows you greater control and continuity of the aspects lists and requires less coordination. However, it may take longer to complete and you may find you have to regularly update your Green Team on progress.

Either way, it is beneficial to actively involve front-line staff and departmental managers in the initial completion and maintenance of the aspects inventory. Employees may be aware of environmental issues and opportunities unknown to management and have ideas on how to address them. Second, involving employees begins to build buy-in and understanding in a way that is real to their work area and their experience. This in turn builds employee ownership in and understanding of the EMS which is key when you will need employees to develop work instructions addressing significant aspects in their work areas, measure environmental performance, and otherwise do things environmentally they might not normally do. Finally, this is also a good opportunity to train employees on how important it will be to keep aspect/impact information up-to-date and to report environmental changes to you or department managers.

Determining Significance

Once you know your aspects and impacts, the next step is to determine which are most significant. You may choose any criteria. While there are no hard and fast rules or requirements, commonly used significance criteria include cost, volume/toxicity of waste, frequency of the environmental aspect, and whether the aspect is regulated or has compliance concerns. These criteria become the filter by which you tell which aspects are most important.

Environmental Management Accounting (EMA) goes hand and hand with identifying costs associated with environmental impacts. EMA identifies, collects, and considers costs over the entire product/chemical life cycle as well as those traditionally "hidden" in overhead. These are often not considered in traditional business decision models. In short, using EMA program can help you be more fully aware of the cost of

alternatives, bringing greater clarity to which projects you should focus on in your EMS through your significance determination.

Determining significance is the perfect area to apply any environmental management accounting information to your aspects and impacts. You should ask your financial representative from your green team for any financial information on existing environmental projects currently in the hospital, and also compile any cost information on perspective options as you go along. Your financial representative may not be the only person who has cost information on these projects, so don't forget to look to other departments as well. Also make sure to consider any costs that might get labeled as overhead cost and assign these to their respective areas. This information will be particularly useful to administration in supporting your EMS, and furthering projects.

Table 3 Significant Evaluation Criteria for Environmental Impacts shows one approach on how to determine significance. The significance ranking method used is based on a scale of one through five. Each of the numbers selected for a given impact in each of the three categories (consequence, frequency, and degree of control) is multiplied to give an overall significance rating. At this particular hospital, any impact that ranked at or above 27, or had legal requirements associated with it, was considered significant.

Change Management and Continual Improvement

When you implement your system, you'll have an initial list of aspects. Not all aspects will be significant, but keep the list as a record nonetheless. As you address your most significant aspects, you'll be able to go on and address the remaining aspects later as part of continual improvement.

Keeping your aspects list current is important. As your activities, products, and services change at your hospital, update your aspects and impacts list. This helps your environmental programs change and stay current. In one case, an automotive manufacturer changed from a lead-based electro-coat material to a lead-free alternative. During the 6-month surveillance audit to maintain its ISO 14001 registration, the facility proudly showed this to its auditors as an example of continual improvement. The auditor congratulated the facility and promptly asked the facility if it had updated its list of aspects to reflect the new waste stream coming out of the modified process.

Train your departmental managers to evaluate any new or future processes, activities, or services for new aspects and impacts and to communicate this information to the EMS representative. Involving and providing training to purchasing staff is especially important. Purchasing often has first-hand knowledge of new equipment and processes and can notify the EMS Representative of new significant environmental issues. New pieces of equipment may be acquired during your hospital's capital budgeting process. Work with your Finance department to identify opportunities to evaluate the environmental impacts of equipment prior to their approval. Such notifications also allow the EMS Representative to identify any potential new regulatory requirements.

Helpful Hints for Getting Started

1. Keep your categories of aspects and impacts general. While your technical proficiency an environmental specialist may allow you to be more detailed, consider that most people in a hospital may not have an environmental/technical background and experience. Keeping categories general helps people more easily understand and brings them on board as participants in aspect identification.
2. When developing your list, you may find that certain activities and thus their resulting aspects and impacts are continuously repeated [ex: waste generation (biomedical, garbage, recycling), operation of office equipment, energy usage, general housekeeping, etc.]. You may choose to combine these activities together under a title such as "General Hospital Operations" to help simplify your inventory.
3. Not all aspects and impacts are negative or detrimental to the environmental. Recycling programs, household hazardous waste collection days the hospital sponsors, and other environmental improvement efforts will have positive aspects you should include when identifying aspects and impact. Recycling, for example, reduces raw material and energy usage and the associated pollution these cause. When you identify these, be sure to include the activity in your inventory and designate the outcome as a positive impact (+).
4. Impacts can relate to the immediate changes to the environment (i.e. vapors from chemical use affecting human health) or eventual changes to the environment (i.e. the

generation of garbage will eventually impact natural resources as a landfill utilizes land space).

Click here to see example healthcare aspects, impacts, and significance determination. Page 140

Objectives and Targets

Setting Performance-Based Objectives and Targets

An EMS requires setting performance-based objectives and targets. *Objectives* are overall environmental goals. *Targets* are detailed performance requirements, quantifiable where possible, set to achieve the objectives.

Consider using your cross-functional Green Team to help brainstorm possible objectives and targets. It is up to you and the hospital to decide on how many objectives and targets to pursue; however, you should consider the following in setting objectives and targets.

- *Significant environmental aspects*. Some of your environmental aspects rated most significant. Are there any you want to set objectives and targets for? For example, you may wish to set an objective of "reduce mercury waste" in hospital with a target reduction of 10% per year.
- *Legal & other requirements*. You may choose to set compliance-based requirements as an EMS objective and target. For example, you may wish to set an EMS objective as "maintain compliance with applicable environmental regulations" and a related target as "submit all required paperwork on time" or "no written notices of violation."
- *Views of external parties*. This is key for hospitals. Input from your patients, visitors, and community neighbors is especially important particularly considering hospitals' mission to protect the health.
- *Technological options*. If technology is not available, you may not be able to pursue certain objectives and targets. At one EMS facility disassembling office copy machines, toner from ink cartridges could not be recycled because cost-

effective technology was not available. At some point, cost-effective technology could become available but until then the toner requires land filling.

- *Financial requirements*. You're not required to pursue objectives and targets that do not make financial sense.
- *Operational & business requirements*. Many EMS organizations are including their environmental objectives and targets in the annual business plan, ensuring that they are in line with overall hospital requirements and receive needed resources. Are there objectives and targets that can operate in line with or otherwise complement other hospital objectives and targets?

Implementation Tips

In addition, you may wish to consider the following tips.

- Make sure your objectives and targets are attainable within reasonable limits.
- Choose a manageable number of objectives for the resources, time and personnel that are available. Narrow your search down by considering the financial and physical resources needed for each objective. Based on available resources, initially, you may only be able to implement those plans that have high payback and low costs.
- Your objectives and targets should be S.M.A.R.T. (Specific, Measurable, Achievable, Results-oriented, and Time-dependant.)
- Don't try to address all environmental issues your first time around. Pace yourself!
- Objectives can focus on individual activities or processes, be department-specific or hospital-wide. The scale of each objective is up to you.
- Develop performance indicators (i.e. how will you measure how well you have done) for each objective and target that can be used as a basis for the overall evaluation of your objectives progress.
- Objective and targets should be periodically reviewed and where necessary revised to incorporate any changes.
- Regular updates of objectives and targets should be given to your Green Team, management and Senior Management Teams.
- Be sure to write down your objectives and targets and train people on what they need to do to help meet objectives and targets that can apply to their work. Various ways

to do this include posting a display and writing an article for your hospital newsletter, etc.

Environmental Management Programs

Environmental Management Programs, or EMPs, are the plans laid out to achieve your objectives and targets. In short, an EMP spells out roles/responsibilities, the action plans, deadlines, and resources needed to accomplish objectives and targets. This information should be documented. The process of setting objectives/targets and EMPs is closely linked; it helps to have an idea of how you will accomplish an objective and target before you set it as a program in your system

How you structure your EMPs is up to you. One automotive manufacturer had an EMP for each major initiative at the facility: one EMP for energy usage, one EMP for solid waste, one EMS for all regulated aspects, and one EMP for PCB elimination. Another facility set the EMPs at the department level, resulting in many more EMPs, but allowing for greater employee ownership and buy-in. However you choose to set your EMPs, you will need to measure your progress. Some measurements are quantitative while others will be more qualitative and subjective. In either case, measure your progress.

You may already have programs similar to EMPs in place at your hospital. If so consider using the same format and approach for your environmental programs. For example, many facilities have already developed formal action plans to decrease biomedical waste to reduce haulage costs, risk and improve health and safety. Even though this goal may not be formally documented, an individual has researched available options and set achievable targets and developed actions to fulfill this goal. This is very similar to what an EMP requires. Key things to consider when working on EMPs include the following.

- Ensure that actions have responsibilities, timelines, and resources for each action item identified.
- Spread responsibility for tasks around to associate managers, members of the Green Team, staff, etc. “Many hands make light work!”

- Don't "invent the wheel" if you don't have to. Ask around and see how other hospitals are addressing the issues you have identified.
- Look to the resources and pollution prevention programs highlighted in this manual.
- Not all objectives are to be completed in a one-year time period (i.e. energy consumption can be a multi-year objective that requires substantial financial budgeting).
- EMPs should be periodically reviewed and where necessary revised to incorporate any changes. As you accomplish objectives and targets and set new ones, your EMPs should correspondingly come into and go out of existence.
- Regular updates of the environmental management programs should be given to the Green Team.

At St. Mary's General Hospital, the Environmental Management Team (Green Team) began implementing achieving its objectives and targets through the following EMPs.

Biomedical Waste Reduction EMP

Biomedical waste management and disposal was one of the hospital's most significant aspects (i.e. highly regulated, significant disposal costs, health and safety issues if handled improperly).

The first step in St. Mary's biomedical waste reduction program was to address the risk, cost and compliance associated with the operation and maintenance of the hospital's incinerator. A formal review of the incineration equipment and usage resulted in the incinerator being shut down permanently. St. Mary's contracted the waste disposal services of a responsible, licensed medical waste hauler who also contractually assisted in the hospital waste reduction efforts. The hospital performed a biomedical waste audit of all departments, focusing primarily on the departments that produced the largest amount of biomedical waste (i.e. Emergency, Operating Rooms, Laboratory). The goal of the waste audit was to review current proper container usage, review staff's knowledge of proper disposal methods and to determine possible waste reduction actions for each area. The audit revealed these findings.

- 70-80% of all the biomedical waste bags were filled with garbage (gloves, plastic, cups, paper towel, etc.;)
- Proper signage was not adequate on containers;
- Some rooms only had biomedical (yellow) bags and all garbage was being disposed in that container;
- Staff were putting objects that could be recycled into red bags and garbage bags;
- Rooms that produced no biomedical waste had red bags ("Just in case!"),
- Staff were not aware of what went into the red bags and what the definition of biomedical waste was; and
- Departments often used large containers for red bags and small containers for garbage. Staff often migrated to the largest, closest container for waste disposal.

Actions resulting from the audit:

- Red bag containers were removed from rooms that only produced garbage;
- Proper signage was placed above the majority of containers to dispel myths about what was to be placed in a red bag;
- Biomedical and garbage containers were switched so that the larger containers contained a black bag;
- Environmental Services (Housekeeping) staff received training on how to properly segregate biomedical waste to help identify departmental problem areas in the future; and
- A hospital-wide "Road-show" on waste education was delivered to all floors. Cookies and treats were brought to each floor to entice the participants (resulted in great attendance).

In *one year* the hospital decreased its biomedical waste stream by 22%, in spite of an 8% increase in surgeries in the hospital's operating rooms (main generators of biomedical waste). To date, even with substantial hospital growth, the segregation efforts of the staff resulted in a 38% reduction in biomedical waste weights since 1998.

It is important to understand that the waste separated out of your biomedical waste stream will primarily be garbage, and hence your landfill weights will increase. To counteract this increase you must evaluate the reuse and recycling programs your hospital has in place.

Recycling and Reuse EMP

When St. Mary's General Hospital first began developing its EMS, the hospital had implemented a few recycling and reuse programs. Most departments had a "blue box" used for glass, cans, plastic, cardboard and newspaper. Many of the administration offices and communication clerk areas had desk side cardboard boxes for paper waste (colored paper, magazines, envelopes, etc.). The Nutrition Department already collected food waste from the cafeteria trays and sent it to a local pig farmer for reuse.

When the Environmental Management Team decided to "improve recycling" as one of its objectives and targets, the hospital had to evaluate current recycling service providers and investigate a number of non-conventional recycling and reuse opportunities. St. Mary's joined forces with two other regional hospitals to develop the "Regional Hospitals Recycling Initiative." By combining negotiations for contracts, the hospitals were able to increase buying power and receive discounted prices for pick-up services. The chosen recycling company would be able to perform "milk-runs" to pick-up the three hospital's glass, cans, plastic, and paper/newsprint recycling containers.

With pick-up service of the "general" recyclables underway, newly purchased recycling containers were dispersed throughout the hospital to incorporate a "segregated" recycling system. The "recycling stations" primarily located in kitchenette areas, lunchrooms, lobby areas and the cafeteria consisted of three slim plastic containers that contained glass, cans, and plastic. The blue boxes that were previously in place were re-designated for cardboard and newspaper. Widely distributed plastic desk side recycling containers replaced the cardboard desk side paper recycling containers. Other recycling efforts included the following.

- Pagers, personal electronic organizers and other information technology devices generate a large number of alkaline and nickel-cadmium batteries. Due to the hazardous nature of this material if disposed (metal and battery acid), the hospital

decided to ship these materials out for recycling and reuse. Plastic buckets (reused from the Nutrition and Food Services department) were placed on floors for battery collection. When the containers are full, Environmental Services staff personnel transport the buckets to battery disposal drums and return empty buckets to the floor. The hospital pays for disposal of alkaline batteries while nickel cadmium batteries are picked-up free of charge.

- Florescent tubes contain mercury vapor, and as "Mercury Free Medicine Campaign" hospital, St. Mary's needed to dispose of the mercury content properly. The hospital enlisted the service of a local company that recycles all fluorescent tube components. When a tube is changed by Engineering Services, (Maintenance) staff, the spent tube is placed back in its original boxes and attached to a skid for transport. In 2001, St. Mary's collected 1,414 florescent tubes resulting in the recycling of 393 kg of glass, 5 kg of aluminum, 6 kg of phosphor powder and 0.04 kg of mercury.
- The hospital was recycling cardboard, but not boxboard (tissue boxes, glove boxes, various supply boxes, etc.). The hospital implemented this recycling alternative and now collects and bails boxboard along with cardboard.
- The Pharmacy department at the hospital also identified re-use opportunities. Drugs and medications needing refrigeration are always delivered in Styrofoam containers with cold packs. The Pharmacy department now offers the Styrofoam containers and cold packs to staff for reuse. The program is widely popular.

Spill Response and Emergency Preparedness EMP

Health care facilities with onsite laboratories utilize a large number of chemicals on a daily basis. In addition, health care facilities have numerous shipments by trucks carrying chemicals or hospital supplies. At anytime, either of these situations could result in a chemical spill, internally or externally. For this reason, one of St. Mary's objectives focused on spill prevention and response.

First, the hospital performed an emergency preparedness audit of high-risk areas. Inventory was taken of all equipment and personal protective equipment. One finding was that all aspects of emergency preparedness and response dealing with fires,

evacuation, disasters (natural and not), and bomb threats had already been adequately addressed through the hospitals emergency code system. However, little information was available on emergency response for internal and/or external chemical spills and handling chemically contaminated casualties. Personal protective equipment and spill clean-up equipment was lacking.

In response, the hospital's Environment, Health and Safety Specialist developed a "Code Brown- Chemical Spill Response Procedure" and assembled a hospital Spill Response Team. The Code Brown procedure dictates what staff and the hospital's Spill Response Team should do in a case of a chemical emergency. The hospital also purchased three hospital spill kits, 4 full-face respirators (in addition to what the hospital had), and personal protective equipment (chemical resistant gloves, suits, and goggles). Each member of the hospital's Spill Response Team receives annual comprehensive spill response training, respirator training, and Code Brown responder training. All new hospital staff receives Code Brown training during their hospital orientation session and existing staff receives annual Code Brown training as a part of the hospital's code review sessions. Since program inception, there have been no reportable chemical spills.

Landscaping Practice EMP

Landscaping provides a variety of environmental challenges including pesticide usage and lawnmower emissions. Hospitals often have immune-deficient individuals entering and leaving the hospital's property. For this reason, St. Mary's recognized the importance of being proactive and eliminating pesticide and herbicide use in current landscaping practices. St. Mary's worked with its current landscaping company to investigate the opportunities available to the hospital. Identified options included the following.

- The hospital developed a "green landscaping policy";
- All spot spraying was stopped;
- Increased aerating, re-seeding and fertilizing are used to reduce herbicide use;
- Shrubbery and other vegetation prone to attacks by pests was promptly removed and replaced with native, drought- and insect-resistant alternatives;
- St. Mary's uses microbial pest intervention to kill lawn grubs;

- Future landscaping plans would reduce the amount of grass around the facility to promote the usage of groundcover, gardens, and other vegetation not requiring such labor-intensive up-keep;
- Scheduled mowing to avoid smog-alert days;
- Use of a natural fertilizer (corn gluten meal) with inherent herbicidal qualities; and
- Use of environmentally friendly alternatives to salt for ice removal on walkways.

Your hospital will most likely choose to include mercury reduction as one of your objectives to establish an EMP. Consider the following ideas in your development.

- Eliminate, reduce, or recycle mercury containing products or waste wherever possible.
- Inventory/preliminary assessment of mercury in equipment, materials (also chemicals and pharmaceuticals), in storage, and in waste streams. Be sure to look at cleaning supplies for mercury-content.
- Gather life-cycle cost of purchasing/using mercury-containing products versus mercury-free products.
- Switch to mercury-free products (e.g., thermometers, lab reagents).
- Segregate mercury-containing products before they get into incinerator waste stream (conduct training).
- Use fluorescent lighting. Fluorescent lighting requires four times less energy than incandescent lighting. This means less mercury emissions at point of power generation.
- Eliminate purchase of mercury-containing products through environmentally preferable purchasing and purchase contracts with vendors/suppliers. Create and enforce agreements with vendors to supply only mercury-free products.
- Develop a broad-based communications program to increase awareness of human health and environmental dangers of mercury.
- Include articles devoted to mercury reduction, handling, and proper disposal in staff newsletters.

- Include specific information about the proper handling of mercury in new-employee orientation and "Right-to-Know" training.
- Ensure that all personnel—including temporary workers—are familiar with the facility's mercury handling procedures and protocols to prevent mercury from being disposed of in sharps containers, red bags, or solid waste containers.
- Include information about waste reduction and pollution prevention in in-service training sessions.
- Encourage personnel to be label readers.
- Place placard or labels on or above red bags, sharps containers, and solid waste containers that state "No Mercury."
- Make sure you have mercury spill kits available in all labs, nursing stations, ICU/ER/Surgery rooms, patient rooms and storage/maintenance facilities.

Click here to see objectives/targets and EMP example procedures. Page 158

Environmental Policy

Developing the Policy

The environmental policy can be created any time during EMS implementation. In the ISO 14001 standard, the environmental policy is addressed first. Some organizations draft the policy first and use it as a first communication from top management to all employees. Other hospitals identify their significant environmental aspects, legal requirements, and objectives and targets prior to developing the policy in order to accurately depict the organization's future environmental goals and guiding principles. Choose whatever process best suits your hospital's needs.

The environmental policy is the cornerstone of your EMS. Like your hospital's mission statement or policy, the environmental policy should ultimately reflect the environmental values and senior management's commitment. Some environmental policies are short and concise; others are more elaborate and detailed. Look at your hospital policy and procedure process to help identify the context in which you might develop this document.

Things to Consider When Writing the Policy

1. Does your policy reflect the values set forth in the hospital's mission statement? Hospital mission statements often include a commitment to provide quality patient care services, promote healthy living, and to provide a healthy and safe workplace for staff and volunteers. Consider supporting statements from your mission when writing your policy. This helps integrate the policy into the overall management of the hospital and may help get Senior Management approval.
2. What are the significant aspects and impacts associated with your hospital's operations, activities, and services? Consider these possible issues when developing the wording in your policy.
3. Consider including any underlying environmental guiding principles, references and/or verbiage from existing environmental policies or procedures, and statements of prior commitment to pollution prevention strategies.
4. Does your policy distinctly include a commitment to continual improvement, pollution prevention, and compliance with applicable legal and other requirements? Does it include a guiding statement referring to how your organization will set environmental objectives and targets? Keep in mind specific reference to these areas in your policy is a requirement of the ISO 14001 standard.
5. Is the policy clear, concise and understandable? The policy will be a tool for EMS communication both internally and externally and should therefore be developed with the end user in mind. One facility implementing an EMS wrote a three-page environmental policy. This long of a policy made it harder for employees to relate to. Generally, an environmental policy should be no longer than a page. You may wish to have an environmental policy statement in addition to the environmental policy. The policy statement is a condensed version of your policy and consists of a statement of your hospital's commitment to continual improvement, compliance with legal and other requirements, and prevention of pollution.
6. Has the environmental policy been signed and dated by your senior most management? Like any corporate policy, you will want the CEO to sign on behalf of your senior management team. In some instances, and depending on your policy

development procedures, you may want your Board Chairperson to sign the policy as well.

7. Is the policy reviewed on a regular basis by your senior management? By dating the environmental policy, you have a reference for when your policy was last reviewed and changes made. Consider reviewing your EMS policy on a yearly basis; however, if your hospital reviews corporate policies every two or three years, you have the opportunity to accept this timeline.

Communicating the Environmental Policy

Hospital Staff

Communicate the environmental policy to all hospital staff. The following is an example of some of the most effective ways to communicate the policy to hospital staff:

1. Post copies of the policy in highly visible, frequently visited locations within the hospital: cafeteria, near the time clock, front or main lobby area, outside main elevator landings, within a permanent environmental display board, outside your CEO's office, on a hospital accomplishment board, and at any other location that staff frequently visit.

The EHS management representative posted the policy, significant aspects, objectives and targets, contractor environmental information sheet on a bulletin board in the hallway between the work and break area. Area supervisors would take their teams to the bulletin board and review this information at the end of the weekly health and safety meeting.

2. One facility put a copy of its environmental policy on the back of the vacation/holiday leave schedule handed out to employees. By hanging onto the vacation/holiday leave schedule, employees would always have a copy of the environmental policy.

3. Many facilities place the environmental policy on a business card-sized insert that can be slipped into the back of staff/visitor ID badges. Other ways of communicating the policy include showing it on the hospital TV network, at hospital entrances/exits, in environmental training, and via email.
4. Post a copy of the policy within your hospital's main policy and procedure manual (either paper or electronic version).

5. Include the policy in your hospital's newsletter.

6. Post the policy on your hospital's website.

7. Ask to include the policy as an agenda item at each departmental staff meeting.

8. If you haven't already done so, ask to be included at your hospital's management meetings. If you get this time, use it wisely. Ask for enough time to cover the definition of an EMS, the contents of the environmental policy, and the EMS roles and responsibilities of management staff. This can be an EMS training opportunity.

9. Educate new staff on the environmental policy during their hospital orientation training. Attach a copy of the environmental policy to their orientation package for reference.

Patients, Visitors, Community

Your environmental policy is the only document in your EMS you must provide externally (if you are pursuing ISO 14001 registration). Posting your policy in a highly visible location within your hospital or on your hospital's web site are just a few ways to provide your policy publicly.

Contractors and Suppliers

Contractors and suppliers should be aware of your hospital's commitment to the environment and the environmental policy. Contractors and suppliers can have an impact on your hospital's environmental performance and will need to follow EMS procedures. There will be times you may need their commitment, particularly on issues such as reducing product packaging, green procurement, and information on products they supply to your hospital.

St. Mary's General Hospital sent recent contractors and suppliers (those with whom the hospital had done business in the prior two years) an environmental awareness brochure outlining the hospital's environmental commitment. Also included was a questionnaire asking for input on how they could help the hospital attain certain environmental goals. Supplier and contractor response was positive and assisted hospital purchasing in developing a "green" products and services database. In turn, participating suppliers were able to promote additional product lines to the hospital for future possible business.

St. Mary's GENERAL HOSPITAL

Environmental Policy

St. Mary's General Hospital is a community-oriented organization, which is committed to the protection of the natural environment by providing patient and community health care services and operating our facility in an environmentally responsible manner. We will strive for continual improvement in our environmental performance and the prevention of pollution through the following goals:

Corporate Commitment

We will comply with all applicable legislation, regulations and other requirements that apply to the hospital's environmental activities, and, wherever possible, we will exceed requirements as legislated.

Protection of Natural Resources

We will contribute to the conservation of natural resources and minimize the release of pollutants through environmentally sound decisions and processes.

Reduce, Reuse, Recycle

We will reduce, reuse and recycle waste wherever possible in order to optimize our utilization of available resources.

Waste Disposal

We will dispose of all waste responsibly to protect the health and safety of our employees, the community, and the environment.

Purchasing Practices

We will continually evaluate our purchasing practices in order to minimize adverse environmental impacts.

Communication and Staff Education

We will ensure that staff, patients, volunteers and physicians are aware of the environmental policies, procedures, and issues within the hospital, through the use of formal training and communication programs.

Environmental Objectives and Targets

We will set and review measurable environmental objectives and targets, and report on our environmental performance.

Monitoring and Evaluation

We will monitor our progress against program goals, and review training, procedures and resources, in order to continually improve our environmental performance set forth in this policy.

Administrative Support

We will support the appropriate administrative structure to ensure institutional compliance with this policy.

Bruce M. Antonello,
President & Chief Executive Officer

Cathy Brothers,
Chair, Board of Trustees

January 24, 2001

Operational Controls

Hospital Considerations

Operational controls are perhaps the most important part of the EMS in terms of actually getting things on the floor done. They provide the "how-to" instruction. You will need operational control(s) in place to address your significant aspects and your objectives and targets. Generally, operational controls are written work instructions like the example shown, but also can include training, test results, and 'control points' like those found in air and water discharge permits. You may choose to have additional work instructions for other important areas. When determining which of these additional work instructions should be documented, consider factors such as task frequency and complexity, personnel turnover, and level of required supervision. Written work instruction can also be an excellent training aid.

Work instructions also help you achieve your objectives and targets. For example, one EMS facility set an objective and target to reduce its hazardous waste by 10% over the upcoming year. It generated one hazardous waste stream associated with lacquer coating copper winding used around electric motors. It implemented three work instructions, or operational controls, to help get to the 10% reduction. One work instruction specified that employees chip lacquer off the mix beaters instead of using new solvent. Another instruction directed the use of used solvent to purge lines and the third specified cleaning lacquer measuring cylinder at the end of the day instead at the end of every shift. All of these together helped the facility reduce the lacquer use and corresponding hazardous waste generation.

Click here to see operational control examples. Page173

Contractors and Suppliers

Communicating environmental requirements to contractors/suppliers is often one of an Environmental Manager's least favorite things to do. However, it can be one area of tremendous "bang-for-the buck" when it comes to environmental performance, particularly considering the environmental impacts contractors can have. Contractor performance can directly impact whether you meet objectives and targets. If, for

example, you have a solid waste reduction objective and target and construction personnel leave their worksite waste for you to dispose of, you're going to have a harder time meeting your waste reduction goal.

You may choose to use a contractor information sheet like the one shown in the Training section to communicate EMS requirements. Be aware that if you send this to corporate office addresses, it may not be communicated on their end to the people that actually come out to your facility and do the work; consequentially, you may need to find alternate ways to make sure such EMS information gets into worker hands. One way is to include it in safety/health training you conduct or in contractor handbooks. Another way is to distribute it at check-in points (e.g., guard gates) at your hospital.

Monitoring and Measurement

An EMS requires you have procedures in place to monitor and measure your environmental performance against your objectives, targets, and significant impacts; to record information that allows performance tracking of operational controls and conformance with objectives and targets; and to evaluate compliance with environmental regulations. Review the kinds of monitoring and measuring you do for regulatory compliance and other purposes such as safety and health you may be able to use these in your EMS. Be sure to think of non-regulated environmental issues such as water and energy usage. Here are some example measures.

- Number of computers and monitors recycled/diverted from landfill (mercury) compared to previous, baseline years. There is mercury in the computer relays and switches in laptop screens and batteries. Computer monitors contain lead. Recycling or otherwise reusing your computer electronics keep mercury and lead PBTs out of the environment.
- Number of mercury spills compared to prior years
- Annual or monthly energy usage (electricity, natural gas, other)
- Water use (normalized)
- Pounds red bag waste reduced (normalized)
- Number of mercury products replaced with mercury-free alternatives

Click here to see an example monitoring and measurement procedure. Page 181

Choose your measures carefully—too many create information overload and an ineffective system, too few may mean you won't have enough information to make good decisions. Information gathered through monitoring and measurement should be used strategically to detect overall performance trends and possible need for corrective and preventive action. This may allow you to identify gradually declining performance and to correct it before it becomes a nonconformance in your system.

You need to calibrate and maintain equipment you use to measure environmental performance. This ensures that readings are true and correct. For example, one facility set a goal of recycling a set percentage of scrap rubber, collected scrap rubber in Gaylord-style crates, and fork-lifted the crates onto a scale for measurement; they calibrated the scale annually and kept records of calibration. In many cases, you may be able to refer to guidelines in equipment manufacturer manuals, rely on calibration your organization or utility already performs, or otherwise subcontract out calibration. When calibration is performed by outside parties, you should still have a record of calibration. Remember to look around for what you already have in place for monitoring and measurement.

Click here to see an example calibration procedure. Page 186

EMS Auditing

Auditing Program Components

Once your EMS is in place, verifying that it is performing as expected will be critical. EMS audits actively check to see if your system is performing as you said it would and, if you are ISO 14001-registered, whether the system is still conforming to the standard. There are several components of an EMS audit program.

- An EMS audit procedure. Several examples are shown at the end of the section. They cover audit team selection and training; preparing a written audit plan; prior notification of audits, audit scope (areas and activities covered), audit frequency; audit methods; key roles and responsibilities,

how audit results are reported and followed up on. Audit results should link to your corrective and preventive action process.

- An internal audit team. The size of your internal audit team depends on the size of your hospital and how many significant impacts your hospital has. You should have enough auditors so that no auditor is auditing his/her own work area and that there are enough backup auditors in the event of illness or turnover. In manufacturing facilities with 200-300 employees, it is common to see anywhere from four to nine internal EMS auditors. Typical internal auditor training includes in-class instruction as well as on-the-job auditing. There are commercially available EMS internal auditor training courses such as those ANSI-RAB offers (www.rabnet.com). These should cover the components of an EMS and good auditing techniques. While new auditors may not have the familiarity with environmental requirements, facility operations, and environmental science, these can often be learned through on-the-job training. One specific technique is to pair an experienced auditor with the trainee. With the right training and on-the-job experience, trainee auditors can become quite proficient in their auditing and findings. At one automobile manufacturer, an internal audit team conducted an EMS audit in the paint booth facility on its own and with the EMS management representative there only to provide ISO 14001 interpretative guidance. The employee auditors on the team led the audit, conducted the questioning, identified findings and presented these findings to the paint booth facility managers on their own.
- Audit frequency and audited areas. Audit frequency should be tied to the importance of the activity being audited and the results of previous audits of that area. Generally, organizations conduct internal audits of all areas at least once or twice a year.
- Maintaining audit records. Audit agendas, audit notes and checklists, and perhaps most importantly, non-conformances written up as a result of the

internal audits are the most common records demonstrating an EMS audit program is in place.

EMS audits help maintain management and employee focus on the EMS and environmental performance, find opportunities to improve the EMS and environmental performance, and ensure that environmental efforts remain cost-effective and tied to the overall hospital mission. At the paint booth facility above, the audit team began its audit in the control room where readings on the incinerator indicated it running at 800 degrees Fahrenheit; subsequent audit team investigation at the incinerator showed it reading over 1200 degrees Fahrenheit. The manager took great interest upon hearing this finding, knowing the energy and cost savings that could be had by lowering the operating temperature.

Click here to see an example EMS audit procedure. Page 188

Audit Program Tips

- Collect objective evidence (e.g., documentation, forms, memos, procedures, policies, and records) of EMS conformance. Auditing should check management commitment to EMS conformance and environmental performance and not focus on why something did or didn't work. Identifying root causes comes later when writing up the corrective action request.
- Auditors should avoid casting their expectations of what they should see and instead focus on what they see during the audit and how it may meet a given requirement.
- Use audit results to identify trends and patterns in EMS deficiencies. These become opportunities for continual improvement.

Emergency Preparedness and Response

Overview of Requirements

One of the most needed EMS sections covers emergency preparedness and response. While many organizations can use what they have in place already, this section really challenges you to review and update (if needed) existing emergency preparedness plans.

You may have these plans under any of a number of US regulatory requirements such as RCRA, SPCC, EPCRA, Oil Pollution Act of 1990, and Hazard Communication. Basically, there are four key points this section requires:

- Assess potential for accidents and emergencies
- Prevent incidents and associated environmental impacts
- Respond to incidents
- Mitigate impacts associated with incidents.

There is a strong emphasis on prevention in an EMS and this applies to emergency preparedness and response also. One area where some organizations need additional work is on identifying and addressing the potential for accidents and emergencies. A good way to start is to ask 'what-if' questions related to hazardous materials, activities, and processes at your site. Consider normal and startup, shutdown, and other abnormal scenarios for possible emergencies also in your assessment.

You are required to periodically test your emergency response procedures (at least annually). Second, you need to review and revise your emergency preparedness and response procedures, particularly after accidents or emergency situations, and to make any necessary improvements. These are there to help ensure emergency response remains suitable, adequate, and effective.

Implementation Tips

- Make sure emergency evacuation routes are clearly posted. At one facility, intricate facility layout diagrams were photocopied down onto an 8 1/2'" by 11" sheet of paper, making it difficult to read. Some diagrams were actually posted in nearly hidden areas. In one case, at floor level near an ice machine in the break area. Make sure your emergency evacuation routes are readable and posted prominently in each work area.
- Make sure SNAFUs are worked out of your emergency system. At one facility during an audit, a worker justifiably required to wear hearing protection in a loud area indicated he could not hear or see emergency lights/sounds during a recent actual emergency. Nor had anyone been assigned to alert him. Upon evacuation and headcount, managers realized he was still in the building and went back to get

him. Learning these kinds of things is an extremely valuable EMS benefit; address such finding promptly.

- Don't forget about visitors and contractors. Would they know what to do in an emergency? This is critical in the hospital environment with a continual flux of visitors.

Click here to see an example EMS emergency preparedness procedure. Page 192

Training

Types of training

Training is key to successfully launching and maintaining any EMS because every employee can have potential significant impacts on the environment as well as ideas on how to improve those impacts. Try to tie EMS training into existing environmental, health, and safety training. There are different kinds of EMS-related training to consider.

1. *EMS awareness* training provided to all employees covers what the policy is, objectives and targets that apply hospital-wide (if any), and general roles and responsibilities (e.g., who the EMS representative is). Good starting questions to training your employees can be found in KPPC's EMS gap audit tool in the Resources section of this manual. Ultimately, you want your employees not simply to rattle off information they need to know, but to understand why the EMS and related information is important. There are many ways to provide this training. One company created a bulletin board displaying the company's policy, significant aspects and impacts, and objectives and targets. During morning meetings, the line supervisors went with the line team to the bulletin board and reviewed this information all the way up to the time of their ISO 14001 registration audit. This approach was excellent for several reasons: 1) it built on a system already in place; 2) the regular meeting established and reinforced the importance of knowing the information; and 3) the employees knew where to go when the auditors asked them questions about these areas of the EMS.
2. *Work-area* training provides task-specific training to employees to understand what environmental impacts their work may have, how they minimize them, and what they need to do to help meet objectives and targets that apply to them.

Consider having written work instructions if not having them documented could result in deviations from your policy or impede your ability to meet your objectives and targets. Written work instruction are an excellent training aid to consider. Employees should also be acquainted with any monitoring and measurement responsibilities that apply.

3. *Compliance* training can tie into work-area specific training. Essentially there are things that employees need to do to follow applicable environmental, health, and safety requirements.
4. *EMS Internal Auditor* training for employees who are expected to perform this function.
5. *Top management* may need additional training to address their special roles and responsibilities in the system. In short, top management is there to ensure the continued suitability, adequacy, and effectiveness of the EMS. They do this through the following roles and responsibilities.
    - Provide resources essential to implementing and controlling the EMS where resources includes things such as human resources (peoples' time and skills), technological resources, and money.
    - Appoint management representative who 1) ensures EMS requirements are established, implemented, and maintained; and 2) reports back on EMS performance and possible need for improvement
    - Participate in EMS Management Review.
6. Should your hospital choose to pursue ISO 14001 registration, you should consider having at least one person attend ISO 14001 *Lead Auditor* training.

Mercury Training Example

Workers at some hospitals were not separating mercury wastes properly, unintentionally disposing of mercury waste in medical waste bound for incinerator. In another instance, a worker reported that broken thermometers are sharp and disposed of them in a "sharps" containers used for waste hypodermic needles. In other instances, workers reported throwing away materials used to clean up mercury spills in infectious "red bag" waste. All three of these instances are good examples of how proper training can keep mercury from getting into our environment.

Click here to see an example EMS training procedure. Page 197

Contractors and Suppliers

Communicating your environmental expectations of suppliers is important. They should at least be aware of your environmental policy; the significant impacts their activities, products or services can cause; and your objectives and targets. One facility put together and sent an EMS information sheet to all its contractors/suppliers (see below). Contractors/suppliers are often partners in meeting EMS objectives and targets. For example, hospitals often set solid waste reduction goals or purchase only mercury-free products. The extent to which you partner with suppliers on these efforts can impact how well you meet and exceed such an objective/target.

You may choose to send an EMS letter and information sheet to your suppliers/contractors; be aware that corporate office do not always communicate the information to the employees who actually come out and work. You may want to have EMS training for contractors/suppliers, perhaps in conjunction with safety training you provide.

[Sample Hospital Document – Revise As Needed]

ENVIRONMENTAL AWARENESS

[HOSPITAL] ENVIRONMENTAL RULES

- Report all environmental emergencies or potential incidents to the EMS Representative, Safety Specialist, Project Coordinator/ Engineer, Department Manager or Supervisor.
- Do not dump any chemical or processed water into the drains or sinks at any time.
- If using new chemicals, they must be approved by the EMS Representative and/or Safety prior to use.
- A MSDS sheet is required for all chemicals, paints, solvents or fluids used in this facility.

ENVIRONMENTAL OBJECTIVES AND TARGETS

Objective	Target
❖ Reduce Solid Waste by:	**6%/yr**
❖ Increase Recycling by:	**5%/yr**
❖ Reduce Hazardous Waste by:	**5%/yr**

- Help us recycle aluminum cans by placing your used cans in the aluminum can recycling containers located in the break room and on the outside patio.
- Increase recycling of cardboard and paper by placing your used cardboard and paper in a recycling container located near you. If you are unable to locate a container, just ask any employee where one is located.
- Performing both of the above tasks will not only increase recycling, but it will also decrease our solid waste.
- Reduction of hazardous waste is accomplished within the Laboratory and waste disposal area(s). Environmental work instructions outline the proper procedure to follow.

All question, concerns or comments should be directed to the **EMS Representative** and/or **Safety Specialist**

All environmental questions from outside sources should be directed to the EMS Representative and/ore Safety Specialist by completing the External Communications Form

WORK INSTRUCTIONS

Operator "Work Instruction" are posted at all work stations. The purpose of these instructions are to describe the work conducted at the station (e.g. setup, inspection, operating perimeters, environmental, etc.)

NECESSARY DOCUMENTATION

Please read and become familiar with the following hospital documents:

[insert title and date of documents]

[Insert the Hospital's Name and Address]

[Insert the Hospital's Logo]

[Insert Hospital Contact Name and Number]

Insert Doc. Number & Document Approval Date

HOSPITAL CREED

In full awareness of our responsibilities as a hospital, we will strive to promote health and well being within the community and within our facility.

QUALITY POLICY

We here at [insert hospital name] have as our quality policy a dedicated focus, by all hospital staff, to provide patients, visitors and the community with service that meets and exceeds their expectations.

Our basic efforts are rooted in the areas of continuous product and process improvement to lower product cost and exceed our customer quality requirements, while providing dependable product delivery.

ENVIRONMENTAL POLICY

We the employees of [insert hospital name] are committed to proactive environmental protection, preventing of pollution, and continual program improvement.

We will continually strive to meet or exceed local, state, and federal environmental regulations and other environmental programs to which the hospital subscribes.

We challenge ourselves to attain our environmental objectives and target, which will be reviewed and revised as needed on an annual basis.

Security Rules

- Never give your badge or ID number to anyone.
- Report all vandalism to the Safety Representative or your Supervisor.

- Never let unknown personnel in the building at any time.
- Report all suspicious activities.
- Report any potential violence or threats of violence.

Important Phone Numbers

Facility Emergencies:

Project Coordinator/Engineer:

EMS Representative:

Safety Specialist:

Security:

Human Resources:

Engineering/Maintenance:

Quality:

Safety

Hazardous Communication Haz-Com

- ❖ A written Haz-Com program is located in the Employee Health office.
- ❖ Material safety data sheets, (MSDS), are located in the Employee Health Office and at each workstation.
- ❖ Labels are required on all containers, NO EXCEPTIONS.

Emergency Evacuation Procedures

Emergency Codes

The hospital has a number of "emergency codes" to handle emergency situations. Please familiarize yourself with the following Codes (full versions available from Department Manager/Supervisor) prior to starting any work at the facility:

[Add in additional Codes as they apply]
The following Codes differ in hospitals. Apply as necessary.

Code Red- Fire
Pull the fire alarm and exit the building. Follow Hospital Code Procedures.

Code Green- Evacuation
Evacuate building as per hospital's Code Green procedure

Code Black- Bomb Threat
Execute site search as per hospital's Code Black procedure.

Code Brown- Internal/External Chemical Spill Response
Ensure the hospital's Spill Team is promptly notified and that spills are properly handled, contained, and cleaned-up as per the hospital's Code Brown procedure.

Additional Emergency Situations/Procedures:

Tornado
Tornado shelters are located in the rest rooms and locker rooms. Proceed to the shelter nearest your work area during a tornado "Warning". A weather radio is monitored for this purpose.

Lock Out Tag Out
Lock Out Tag Out procedures are to be followed when performing maintenance on machines or other equipment that could cause injury by the unexpected release or start up of energy. The Supervisor of the Engineering/Maintenance department will have the lock and key.

Accidents
Report all accidents to your Supervisor or Safety Representative **immediately**. Failure to do so can result in corrective action. This facility has trained First-aid personnel that can assist with injuries and/or make arrangements for further treatment.

Fork Lift
No employee is allowed to operate a fork lift unless they have completed the fork lift operators course.

Getting Started

Providing the EMS work area and compliance training is time-intensive. You already provide compliance training and know what job positions can impact whether you stay in compliance. Do the same for significant aspects. First, identify your significant impacts and determine where these are in your hospital. Second, determine which job positions are tied most closely to the impacts. These are the folks for whom you will want to provide EMS work-area training. In some cases, you may be able to combine your EMS and compliance training. Consider establishing a training matrix outlining which employees' work is tied most closely to the significant impacts and objectives and targets, which training each job function should receive, and how often the training is needed.

Frequency of Training

Much of your training efforts will be as you implement and start the EMS. There may be other times down the road you will need to repeat the training described above. Examples include new employees; employees transferred across work areas within the hospital; introduction of new activities, products and services; new contractors and suppliers; and as part of corrective/preventive actions.

Lessons Learned

- Many EHS managers focus on EMS implementation as a two-step process. First, write EMS documentation, and then train people on what they need to know of/from the documentation. This can prove to be a faulty approach depending on how involved staff has been in writing the procedures and documentation. If staff involvement is minimal, it will take more training time to bring them up to speed. Further, their buy-in and involvement may be harder to obtain later in the process. Plan extra training time with this approach! It is advisable to seek staff input in writing work instructions.
- Incorporate needed EMS training into existing, already required training or meetings (for example, use your Management Review as a time to provide EMS

training to top management). People will appreciate this approach over having to attend additional meetings.

- How you provide training is up to you! One EHS manager spread the word on the policy, significant aspects, and objectives and targets by posting these on an EMS bulletin board near the time clock where employees waited to punch in/out.
- Look for opportunities to begin training early. Training is one way of communicating your EMS efforts and building familiarity. Be sure to communicate the results of people's work back to them, particularly on successes!
- Don't forget about the training qualifications of individual providing the EMS training. How are you and others prepared and qualified to give EMS training.

Communication

Most organizations already have procedures in place on how they communicate their policies internally and externally. If you've been implementing your system as you've been reading this manual, you've undoubtedly been in communication on various issues with various people in your hospital—top management, fellow EHS staff, doctors, nurses, and other staff throughout the hospital.

External Communication

An EMS requires that you communicate internally and externally. The only thing you are required to provide externally is your environmental policy. In practice, you probably provide much more information about your environmental efforts through P2 plans, annual reports, regulatory records, and emergency response planning. However, it is ultimately up to you what, if anything, you provide on the EMS beyond the policy. You do need to have a procedure, though, to handle external requests for information on the EMS. The basics you should document for external requests include who made the contact, the date, the nature of the request and response, and what, if any, materials were sent.

There are various interested parties who may request information on your EMS. While environmental groups generally spring to mind first for most EHS managers, there are other potential interested parties including other hospitals, state and federal regulatory

authorities, contractors/suppliers, local emergency officials, and neighbors. Your external communication procedure may say that you'll consider requests on a case-by-case basis, giving you the flexibility to assess the credibility of the contact and what information you provide.

Click here to see an example EMS external communication procedure. Page 204

Internal Communication

What an EMS requires is that you have a formalized procedure for how you communicate EMS information at various levels and functions throughout the hospital. This doesn't preclude informal communication, but attempts to ensure some way of consistent and systematic communication. Information you'll need to communicate internally includes the EMS policy, responsibilities, and results. Environmental aspects (and subsequent changes to aspects) needs communicated. Changes such as revised objectives and targets, updates to existing procedures, environmental incidents, and new regulatory requirements will also need communicated. Your internal communication procedure should have some way to receive feedback from employees on the EMS and environmental performance; in other words, communication on the EMS needs to be two-way.

Training will be one of your most common ways to communicate with people throughout the hospital but there are many other ways including email, in-house television, and newsletters. Think through which are most effective at your hospital and use them. The type of EMS information you share will depend on your audience. Refer back to the Training section for the basics of who needs to know what on the EMS. Tailor the nature and frequency of communications to your peoples' expectations and needs. This varies from organization to organization.

Click here to see an EMS internal communication procedure and form. Page 206

Documentation/Document Control

No part of an EMS causes more stress, it seems, then documentation and document control. It is the reason most argued against implementing an EMS. But how you tackle your documentation will have a direct bearing on how much of a task it is to develop and maintain. And despite the criticism, documentation proves in hindsight to be one of the most significant benefits for many EMS organizations. Where preventing the

loss of operational details, controlling the sequence of activities or events, or consistency of results or outcomes is important, documentation will be valued accordingly. Documentation such as written work instruction can be a valuable EMS training aid.

While there are some basic documents you should consider having (see List of Documents), your hospital ultimately makes the call as to what and how to document. There are practical considerations you should think about in deciding whether and how much to document. First, if the task is important enough for two people to do the same way, document. The system has to work and make sense for you. Second, determine if there is any existing documentation within your hospital you can use to meet the EMS requirement. If so, with needed modification, you can use it for your EMS and save considerable time and expense. Third, use the 'new employee' test to determine if there is sufficient detail in the procedure. That is, once you write a piece of documentation, is there enough detail there that someone new to the position could pick up the documentation and successfully complete the task? This is a critical test because it challenges you to write down the knowledge and more importantly, the experience, that people walking around have in their heads. This requires talking to your employees.

Many times organizations don't incorporate this experience in their work instructions and procedures, generating interesting consequences. The facility saves time in the short run by shortchanging the details, but upon completion and use of their documentation on the floor, is left feeling like something is missing from having gone through the whole exercise of preparing the documentation. The documentation proves not all that helpful and people don't use it. Sometimes there are less subtle consequences. At one industrial chemical facility, there were two augers that connected to provide chemical feed to a storage pump that had to be replaced periodically. There was one maintenance man who knew from experience how to "jiggle" the augers to get them to align so they wouldn't contact and spark upon operation. When he left the company, the experience went out the door. Upon subsequent replacement of the augers, misalignment and sparking occurred, causing a fire and shutting down production. Luckily, no one was hurt.

LIST OF EMS DOCUMENTS

Typical Environmental Management System Manual Documentation

- **Annual Objectives and Targets**
- **Action Plan (to achieve objectives and targets)**
- **Tracking and Measuring Progress**
- **Master Document Control List**
- **Organization-wide Procedures (in some cases, could be several procedures)**
    - Environmental Aspects and Other Requirements
    - Access to Legal and Other Requirements
    - Training, Awareness and Compliance
    - Internal Communication
    - External Communication
    - Document Control
    - Change Management Process(es)
    - Management of Suppliers/Vendors
    - Emergency Preparedness and Response
    - Monitoring and Measurement
    - Calibration and Maintenance of Monitoring Equipment
    - Compliance Evaluation
    - Corrective and Preventive Action
    - Records Management
    - EMS Auditing
    - Management Review
- **Procedures/Work Instructions for Specific Operations or Activities**
    - E.g., Waste Management
- **Forms, Drawings, and Checklist (that support the EMS procedures)**

You will likely need an EMS manual. The manual should contain the environmental policy, a master document control list, your main procedures, and work instructions (if you choose). The master document control list is essentially a road map to all of your EMS documentation. It should list the name of the document, where it is kept, and the most recent revision. The basic purpose of listing the most recent revision is for document control purposes.

Document control helps make sure everyone's working from the latest version of how your hospital does things. If possible, set up your EMS document control system electronically. Instead of having to replace multiple paper copies, you change out one electronic copy. Plus, employees can pull up documents easier from their work location. Other document control pointers include the following.

- Choose who must approve documents carefully. Choosing too many people or individuals rarely in the office (e.g., due to work travel) will make document control difficult.
- Frequency of revision. Some documentation such as work instructions may change somewhat frequently. Other documentation such as the environmental policy and your system procedures will be fairly static.
- Communicate changes in documentation. There are various ways to do this. Training is one way. Highlighting the changes in the procedures or documentation for one revision is a visual reminder. At the back of each procedure, consider having a table (as shown in examples) for recording changes to procedures.
- Build on existing document control systems where possible.
- Pay attention to location, availability and protect against loss. If your documentation is all electronic make sure it's backed-up to a safe location. If your documentation (e.g., compliance reports) is hard copy, consider storing in locked, fireproof cabinet.

Click here to see and example EMS document control procedure and Master Document Control list. Page 211

Record Keeping

Records are historical in nature; they prove that your EMS is working as you indicated it would in your documentation. Along with documentation, record keeping requirements are probably the most maligned part of what an EMS requires. But how you tackle this has a lot to do with how easy or difficult it is. Focus on records that add value. Don't keep unnecessary records. Other tips to consider include the following.

- Determine who will have access to records.
- Determine how records will be kept. Consider storing hard copies in locked, fireproof cabinets. Electronic records should be backed up and the backup copy stored in a secure location.

- Think about retention and destruction issues. Factors to consider in how long to keep a records are: 1) any legally mandated retention requirements (e.g., in U.S., organizations must generally keep Clean Air Act documentation for five years); 2) hospital retention guidelines; and 3) the usefulness of the record to your organization. Consider carefully what to record and how long to keep. At one facility, an accident occurred involving a forklift operator. Upon review of the operator's training exam, it was observed that the operator had incorrectly answered a question, demonstrating management knowingly not correcting the problem. This record was used against the company during legal proceedings. Record should have been made at the time of training that the correct answer was reviewed with and understood by the operator.

You may choose to have a Master Records List and include in your EMS manual. Some records to keep for your EMS include the following.

Aspect/impact identification & evaluation
Compliance-related materials including permits, reporting, notifications, etc.
Performance measurements against significant impacts and objectives and targets
Monitoring equipment calibration
Sampling monitoring data
Internal/external EMS correspondence
Testing of procedures (e.g., under emergency preparedness and response)
Decision on external communication
Changes from corrective & preventive action
Training records
Audit results
Management review

Click here to see an EMS recordkeeping procedure. Page 219

Management Review

Management review is the point in EMS operation that ensures continued suitability, adequacy, and effectiveness. Making sure the EMS remains cost-effective is a priority. In short, an EMS requires you have management review at least once a year. Some organizations insist on having management review two, three, and sometimes even four times a year. Inevitably, this changes the nature from a longer-term, strategic outlook to one with a shorter outlook; the review no longer meets what it was meant for.

Management review looks at performance trends over the past year and in the future. In particular, these are things your top managers should consider in management review. Remember, top management is how you define it in your EMS; top management is expected to show up and participate in the review

- Are EMS roles, responsibilities, and procedures clear, applicable, and relevant?
- What effects have changes in materials, products, or services had on our EMS and its effectiveness?
- Are there patterns in non-conformances showing up from internal EMS or compliance audits that need addressed?
- Are there compliance requirements could impact the hospital in the future for which we need to plan and allocate resources?
- Are there changes we need to make to the policy, objectives & targets, or EMS? Is progress being made toward current objectives and targets?
- Are there any trends in performance date from EMS monitoring and measuring?
- What stakeholder concerns (if any) have been raised since last review?

Consider using management review is a key training opportunity to train managers on the EMS. Be sure to document who is at the meeting, items discussed, decisions made, and who is responsible for which follow up action(s).

Click here to see an EMS management review procedure. Page 226

Additional System Examples

Table 1: Example Aspects and Impacts for a Health Care Facility		
Activity/Service	**Aspect**	**Possible Impact(s)**
1. Nursing/Medical Floors/Operating Rooms/Day Surgery/Emergency/Intensive and Critical Care Units/Isolation Areas, etc.		
Basic Patient Care (including surgical procedures, daily care, isolation cases, etc.)	Solid waste generation (packaging, use of disposable materials, etc.)	Potential water pollution from leaking landfill, Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
	Biomedical waste generation (sharps, items contaminated with blood and/or body fluids, isolation supplies, etc.)	Human Health, Air Pollution (e.g. incineration), Waste (Hazardous), Natural Resource Depletion (Land).
	Raw material usage (cleaning chemicals, sterilants, high-level disinfectants, formaldehyde, medications, etc.)	Human Health, Resource Depletion (e.g. raw material depletion)
	Potential chemical spills (emergency)	Human Health, Air/Water Pollution, Resource Depletion (e.g., raw material depletion)
Operation of Medical and Other Equipment	Energy usage	Air, Water, and Soil Pollution (e.g. air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Hazardous waste generation (batteries)	Human Health, Waste (Hazardous), Natural Resource Depletion (Land)
Compressed Gas Usage (oxygen, nitrous oxide, etc.)	Raw material usage (chemicals)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible fire hazard (emergency)	Human Health, Air Pollution (e.g. smoke)
	Chemical leakage (emergency)	Human Health, Air Pollution (e.g. chemical vapors), Resource Depletion (e.g., raw material depletion)
Laser Usage	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Possible fire hazard (emergency)	Human Health, Air emissions (smoke)
	Possible occupational exposure to radiation	Human Health
2. Diagnostic Imaging (Nuclear Medicine, X-Ray, Radiology, Ultrasound, Cat Scan, Cardiac Catherization Procedures, etc.)		
Basic Patient Care (Operating Medical Equipment, Performing Invasive Procedures and Contrast Injections)	Biomedical waste generation	Human Health, Air Pollution (e.g. incineration), Waste (Hazardous), Natural Resource Depletion (Land)
	Radioactive biomedical waste generation (Half-life of radioactive isotope must be spent before leaving department)	Human Health, Air Pollution (e.g. incineration), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
	Solid waste generation (packaging, use of disposable materials, etc.)	Air, Water, or Soil Pollution (e.g. potential water pollution from leaking landfill), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
	Raw material usage (cleaning, high-level disinfectant, etc.)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible ehemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors), Waste (Hazardous)
	Possible occupational exposure to radiation during x-ray process	Human Health
	Minor radioactive excreta sanitary disposal	Natural Resource Depletion (water)
	Possible radioactive spill (emergency)	Human Health, Waste (Hazardous)
Film Processing (Wet and Dry Laser)	Solid waste generation (packaging, film, etc.)	Air, Water, or Soil Pollution (e.g. potential water pollution from leaking landfill), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
	Raw material usage (film processing chemicals, plastic film, etc.)	Human Health, Resource Depletion (e.g. raw material depletion)
	Water consumption	Natural Resource Depletion (water)
	Wastewater discharges (depends on state or socal water regulations)	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
	Silver recovery from film	Positive Impact (reduced impacts on air, water, soil (pollution); reduced energy resources impacts (combustion & depletion of natural resources); reduced impacts on mineral resources (depletion)

Nuclear Laboratory Work	Possible occupational exposure to radiation	Human Health
	Possible Air emissions (often fume hoods are used as precautionary measures when preparing injectables)	Human Health, Air Pollution (e.g. vapors discharged through fume hoods)
3. Laboratory (Histology, Pathology, Morgue, Autopsy, Blood Bank,		
Daily Operation of Analysis Machines (Aspects may differ depending on the type of equipment and how the chemical waste is disposed of)	Biomedical waste generation	Human Health, Air Pollution (e.g. incineration), Waste (Hazardous), Natural Resource Depletion (Land).
	Hazardous waste generation	Human Health, Air Pollution (e.g. chemical vapors), Waste (Hazardous), Natural Resource Depletion (Land)
	Raw material usage (chemicals)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors)
	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges (depends on state or local water regulations)	Air, Water, or Soil Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
Manual Analysis (urine, blood, staining, etc.)	Biomedical waste generation	Human Health, Air Pollution (e.g. incineration), Waste (Hazardous), Natural Resource Depletion (Land).
	Raw material usage (chemicals)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill	Human Health, Air Pollution (e.g. chemical vapors)
	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges (depends on state or local water regulations)	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (Water)
Chemical Use, Transportation, & Disposal	Raw material usage (chemicals)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill	Human Health, Air Pollution (e.g. chemical vapors)
	Air emissions	Human Health, Air Pollution (e.g. chemical vapors)
	Hazardous waste generation	Human Health, Air Pollution (e.g. chemical vapors), Waste (Hazardous), Natural Resource Depletion (Land)
	Possible fire/explosion hazard	Human Health, Air Pollution (e.g. smoke, chemical vapors)
	Possible wastewater discharges (depends on state or local water regulations)	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (Water)
Flammable Storage Rooms	Chemical Storage & Raw material usage (chemicals)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors)
	Possible fire/explosion hazard	Human Health, Air Pollution (e.g. smoke, chemical vapors)
	Air emissions	Human Health, Air Pollution (e.g. chemical vapors)
Chemical Recycling (Process is used to reclaim used chemicals such as alcohol, Formalin, Xylene, etc.)	Raw material usage (chemicals)	Human Health, Resource Depletion (e.g. raw material depletion)
	Chemical Recycling	Positive Impact (+) (e.g. reduced purchase of chemical, reduced impacts associated with disposal)
	Air emissions	Human Health, Air Pollution (e.g. chemical vapors)
	Hazardous waste generation	Human Health, Air Pollution (e.g. chemical vapors), Waste (Hazardous), Natural Resource Depletion (Land)
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors)
	Possible fire/explosion hazard	Human Health, Air Pollution (e.g. smoke, chemical vapors)
Processes Utilizing Fume Hoods and Ventilation Equipment	Air emissions	Human Health, Air Pollution (e.g. chemical vapors)
	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
4. Environmental Services/ Housekeeping		
High-level Disinfecting and Cleaning Procedures	Raw material usage (chemicals)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors)

	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
	Air emissions (ex. chemicals used for stripping floors)	Human Health, Air Pollution (e.g. chemical vapors)
Transporting Biomedical Waste	Possible Biomedical Waste Spill (Emergency)	Human Health, Air Pollution (e.g. incineration), Waste (Hazardous), Natural Resource Depletion (Land).
Laundry (may be a separate department at your hospital or contracted off-site)	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Raw material usage (detergents, fabric softeners)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors)
	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
5. Central Sterilization		
Operation of Ethylene Oxide Sterilizer	Compressed Gas Storage and Raw material usage	Human Health, Resource Depletion (e.g. raw material depletion)
	Air emissions	Human Health, Air Pollution (e.g. chemical vapors)
	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Solid waste generation (packaging, use of disposable materials, etc.)	Air, Water, or Soil Pollution (e.g. potential water pollution from leaking landfill), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
Operation of Hydrogen Peroxide Sterilizers	Raw material usage (Hydrogen peroxide, packaging, etc.)	Human Health, Resource Depletion (e.g. raw material depletion)
	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
Operation of High Temperature/ Pressure/ Steam Sterilizers	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
Biological Testing	Biomedical waste generation	Human Health, Air Pollution (e.g. incineration), Waste (Hazardous), Natural Resource Depletion (Land)
6. Nutrition/ Food Services/ Cafeteria/Restaurants		
Dish Machine Operations, Belt Lines and Other Food preparation processes	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges (some hospitals use garberators where food is shredded and disposed of down sanitary sewer)	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
	Raw material usage (detergents, etc.)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors)
	Solid waste generation (packaging, use of disposable materials, etc.)	Air, Water, or Soil Pollution (e.g. potential water pollution from leaking landfill), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
	Solid waste generation - Recycled (food waste, plastic, cans, glass, etc.)	Positive Impact (+) (reduced natural resources needed for landfill)
7. Pharmacy		
Preparing Antineoplastic/ Cytotoxic Drugs	Biomedical waste generation (Cytotoxic/Antineoplastic drugs)	Human Health, Air Pollution (e.g. incineration), Waste (Hazardous), Natural Resource Depletion (Land)
	Air emissions (Requires Fume Hood)	Human Health, Air Pollution (e.g. chemical vapors)

	Possible Occupation Exposure to Cytotoxic Material	Human Health, Air Pollution (e.g. chemical vapors)
Disposing of Narcotics (Possible on-site disposal by Pharmacists)	Biomedical waste generation (May be regulated in your area-to dispose of narcotics already rendered unrecoverable)	Human Health, Air Pollution (e.g. incineration), Waste (Hazardous), Natural Resource Depletion (Land)
Needle, Vial, IV Bag, Drug Return Disposal	Generation of Biomedical Waste (May be regulated in your area)	Human Health, Air Pollution (e.g. incineration), Waste (Hazardous), Natural Resource Depletion (Land)
8. Physiotherapy/ Occupational Therapy, Wellness Clinics, Recreational Therapy, etc.		
Daily Operation of Equipment (ex. Wax Machine, Hydrocollator, Whirlpool, Ultrasound, Laser, etc.)	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Solid waste generation (packaging, use of disposable materials, etc.)	Air, Water, or Soil Pollution (e.g. potential water pollution from leaking landfill), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges (depends on state or local water regulations)	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
	Raw material usage (These departments mainly use cleaning chemicals and possibly chlorine for the whirlpool)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill	Human Health, Air Pollution (e.g. chemical vapors)
9. Engineering/Maintenance		
Operation of Powerhouse Equipment (Boilers, Water Softeners, Dealkalizers, Fire Pumps, Vacuum Pumps, Medical Air Pumps,	Energy usage (powerhouse equipment are high consumers of energy- often to produce energy)	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Air emissions (often regulated discharges through a stack)	Human Health, Air Pollution (e.g. emissions as a result of combustion, chemical emissions, etc.)
	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges (ex. blow down from boiler, flushing pumping systems, etc.)	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
	Raw material usage (there are a number of chemicals, mainly in drums, used for Powerhouse equipment)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors)
	Fuel consumption- natural gas (back-up diesel fuel)	Natural Resource Depletion (e.g. natural gas, oil, hydro-electricity, etc.)
Cleaning Salt (Brine) Tank	Hazardous waste generation	Human Health, Waste (Hazardous), Natural Resource Depletion (Land)
Welding/Cutting Metal	Air emissions	Human Health
	Scrap metal recycled	Positive Impact (+)
	Chemical (compressed gas) use as fuel-acetylene, oxygen, argon, etc.	Human Health, Air Pollution (e.g. smoke, chemical vapors)
	Compressed Gas Storage	Human Health, Air Pollution (e.g. chemical vapors)
	Noise/Heat/Radiation Exposure	Human Health
	Possible Fire/Explosion (Emergency)	Human Health, Air
PCB Storage (Outside or Inside)	Possible PCB Leak (Emergency)	Human Health, Groundwater, Storm Sewer
Asbestos Handling and Removal	Hazardous waste generation (Asbestos)	Human Health, Air Pollution (e.g. airborne asbestos fibers), Waste (Hazardous), Natural Resource Depletion (Land)
	Air emissions	Human Health, Air Pollution (e.g. airborne asbestos fibers)
	Possible Improper Handling of Asbestos Waste (Emergency)	Human Health, Air Pollution (e.g. airborne asbestos fibers)
Above-Ground and/or Under-Ground Storage Tanks	Possible Fuel Spillage (Emergency)	Human Health, Air Pollution (e.g. vapors)
	Air emissions	Human Health, Air Pollution (e.g. vapors)
Operation of Diesel Generator (Back-Up Power)	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Fuel Consumption (Diesel)	Natural Resource Depletion (e.g. diesel oil)
	Air emissions	Human Health, Air Pollution (e.g. vapors)
	Possible Fire Hazard (Emergency)	Human Health, Air Pollution (e.g. smoke, vapors)

Electrical Operations (repairing electrical equipment, changing light fixtures and ballasts, etc.)	Hazardous waste generation- Possibly Recycled (Fluorescent Tubes, Ballasts)	Positive Impact (+) if Recycled, if not, Human Health, Air Pollution (e.g. mercury vapor), Waste (Hazardous), Natural Resource Depletion (Land)
	Hazardous waste generation- PCB Ballasts (if you have these in your facility), Mercury (small mercury pods in light switches)	Human Health, Air Pollution (e.g. chemical/mercury vapor), Waste (Hazardous), Natural Resource Depletion (Land)
	Solid waste generation (packaging, use of disposable materials, etc.)	Air, Water, or Soil Pollution (e.g. potential water pollution from leaking landfill), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
	Possible Electrical Fire/Electrical Shock	Human Health, Air Pollution (e.g. smoke)
	Scrap Electrical Wire - Recycled	Positive Impact (+) – (decreased natural resources required for landfill)
Cooling and Heating Processes	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
	Air emissions	Human Health, Air Pollution (e.g. chemical vapors)
	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Raw material usage (biocides)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors)
Painting Processes	Raw material usage (Latex, alkyd and oil-based paints, varsol, urethane, etc.)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors)
	Air emissions (chemical, dust from sanding drywall, etc.)	Human Health, Air Pollution (e.g. dust, chemical vapors)
	Water consumption	Natural Resource Depletion (Water)
	Wastewater discharges (process of cleaning brushes)	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
	Hazardous waste generation	Human Health, Air Pollution (e.g. chemical vapors), Waste (Hazardous), Natural Resource Depletion (Land)
	Solid waste generation (packaging, use of disposable materials, etc.)	Air, Water, or Soil Pollution (e.g. potential water pollution from leaking landfill), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
10. Shipping/Receiving/Stores		
Receiving, Storing and Transporting High Risk Supplies (Chemical, Pharmacy, Radioactive, etc.)	Chemical Storage (Priority, high risk items should be transported to their designated destination immediately after arrival, however, due to timing there may be a period of time where these items are stored)	Human Health, Air Pollution (e.g. chemical vapors)
	Possible Radioactive Isotope Spillage (Emergency)	Human Health
	Possible chemical spill Internal/External (Emergency)	Human Health, Air Pollution (e.g. chemical vapors), Other- Flora and Fauna
	Possible fire/explosion hazard	Human Health, Air Pollution (e.g. smoke, chemical vapors)
Unpacking Supplies	Solid waste generation (packaging, use of disposable materials, etc.)	Air, Water, or Soil Pollution (e.g. potential water pollution from leaking landfill), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
	Solid waste generation - Recycled (cardboard, boxboard, plastics, etc.)	Positive Impact (+) (decreased natural resources needed for landfill)
11. Landscape Management/ External Environment		
Grounds-keeping Practices	Water consumption	Natural Resource Depletion (Water)
	Raw material usage (Pesticides/ Herbicides/ Fertilizers)	Human Health, Resource Depletion (e.g. raw material depletion), Air emissions, Groundwater contamination , Impact to local Flora and Fauna
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors), Water Pollution (e.g. storm sewer, groundwater), Other- Flora Fauna
Snow Removal/Salting During	Raw material usage (salt, sand,	Human Health, Resource Depletion (e.g. raw material

Winter Months	environmental alternatives available)	depletion), Other- Flora and Fauna
Use of Equipment (Gas-Powered Lawn Mowers)	Air emissions (Particularly problematic to passing staff, visitors, etc., on high SMOG Days)	Human Health, Air Pollution (e.g. combustion emissions), Other- Flora and Fauna
	Fuel Consumption	Natural Resource Depletion (e.g. gasoline, oil)
12. General Hospital Operations & External Concerns		
General Hospital-wide operations and Administration Processes	Solid waste generation (packaging, use of disposable materials, etc.)	Air, Water, or Soil Pollution (e.g. potential water pollution from leaking landfill), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
	Solid waste generation – Recycled (paper, cardboard, boxboard, plastic, cans, glass, etc.)	Positive Impact (+) (decreased natural resources needed for landfill)
	Energy usage (office equipment-computers, photocopiers, personal radios, heaters, fax machines, lighting, etc.)	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Air emissions (possible photocopier emissions)	Human Health, Air Pollution (e.g. chemical vapors)
	Water consumption (toilets, sinks, water fountains, etc.)	Natural Resource Depletion (Water)
	Wastewater discharges (toilets, sinks, water fountains, etc.)	Water Pollution (e.g. chemical contamination to water), Natural Resource Depletion (water)
Use of Mercury Containing Devices	Possible chemical spillage (Emergency)	Human Health, Air Pollution (e.g. chemical vapors)
On-Site Waste Disposal (Incineration)	Air emissions	Human Health, Air Pollution (e.g. combustion emissions)
	Heat/Noise/Vibration	Human Health
	Generation of Hazardous and Non-Hazardous Waste (Ash may be considered hazardous or non-hazardous depending on your state regulations)	Human Health, Air Pollution (e.g. combustion emissions), Waste (Hazardous), Natural Resource Depletion (Land)
	Possible fire/explosion hazard (Depending on what is put into the incinerator- look to state regulations to determine what waste can be disposed of by incineration)	Human Health, Air Pollution (e.g. smoke, combustion emissions)
Compressed Gas Storage	Possible Air emissions/Gas Leak (Emergency)	Human Health, Air Pollution (e.g. chemical vapors)
	Possible fire/explosion hazard (Emergency)	Human Health, Air Pollution (e.g. chemical vapors)
Parking Lots	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors), Water Pollution (e.g. storm sewer, groundwater), Other- Flora and Fauna
Railway or Highway Environmental Incident (in close proximity to your hospital's location)	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors), Water Pollution (e.g. storm sewer, groundwater), Other- Flora and Fauna
	Possible fire/explosion hazard (Emergency)	Human Health, Air Pollution (e.g. chemical vapors), Water Pollution (e.g. storm sewer, groundwater), Other- Flora and Fauna
Local Industry Environmental Incident (in close proximity to your hospital's location)	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors), Water Pollution (e.g. storm sewer, groundwater), Other- Flora and Fauna
	Possible Fugitive Air emissions (resulting in external air exclusion procedures)	Human Health, Air Pollution (e.g. chemical vapors), Water Pollution (e.g. storm sewer, groundwater), Other- Flora and Fauna
Construction- Demolishing and Re-building Structures	Solid waste generation (materials not reusable or recyclable)	Air, Water, or Soil Pollution (e.g. potential water pollution from leaking landfill), Natural Resource Depletion (Land), Resource Depletion (e.g., raw material depletion)
	Fuel Consumption- (mainly mobile equipment)	Natural Resource Depletion (e.g. natural gas, oil, hydro-electricity, etc.)
	Energy usage	Air, Water, or Soil Pollution (e.g., air pollution and other pollution products from combustion), Natural Resource Depletion (e.g. oil, natural gas, etc.)
	Air emissions- exhaust from forklifts, trucks, dust, fugitive emissions, etc.	Human Health, Air Pollution (e.g. combustion emissions), Other- Flora and Fauna

	Compressed Gas Use and Storage	Human Health, Air Pollution (e.g. chemical vapors), Other- Flora and Fauna
	Possible fire/explosion hazard	Human Health, Air Pollution (e.g. smoke, chemical vapors), Other- Flora and Fauna
	Noise and Vibration	Human Health
	Raw material usage (chemicals, construction materials, etc.)	Human Health, Resource Depletion (e.g. raw material depletion)
	Possible chemical spill (emergency)	Human Health, Air Pollution (e.g. chemical vapors), Other- Flora and Fauna
Other Areas to Consider Including:		
Day Clinics		
Special Testing		
Off-Site or Satellite Facilities		
Mobile Units owned and operated by the hospital such as Ambulance and Patient Transport services		

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TABLE 2: SAMPLE ENVIRONMENTAL ASPECTS AND IMPACTS INVENTORY FORMAT

DEPARTMENT: Nursing/Medical Floors

DATE APPROVED: 04/04/01

DATE LAST REVIEWED: 10/04/02

Impact Abbreviation Definitions: AIR: Air/Atmosphere, SOIL: Soil , GW: Groundwater/Waterway, ST.S: Storm Sewer , SN.S: Sanitary (City) Sewer (water to be treated at wastewater treatment plant), WASTE- HAZ: Hazardous Waste, WASTE-NON: Non-Hazardous Waste (i.e. recycled, garbage, etc.) , HH: Human Health effects (patients, visitors, staff, community), NR: Natural Resources (renewable or non-renewable) , OTHER: Other negative environmental issues

ACTIVITY/SERVICE	ENVIRONMENTAL ASPECT	LEGAL REQ'MNTS	POTENTIAL AREA(s) OF IMPACT (positive impacts +)								CONSEQ. RATING	FREQ. RATING	DEGREE OF CONTROL	TOTAL SIGNIF.
			AIR	SOIL	GW	ST.S/ SN. S	WASTE		HH	NR	OTHER				
							HAZ	NON							
Basic Patient Care (including surgical procedures, daily care, isolation cases, etc.)	Solid waste generation (packaging, use of disposable materials, etc.)		X	X	X					X (land)	Resource Depletion				
	Biomedical waste generation (sharps, items contaminated with blood and/or body fluids, isolation supplies, etc.)		X				X		X	X (land)					
	Raw material usage (cleaning chemicals, sterilants, high-level disinfectants, formaldehyde, medications, etc.)								X		Resource Depletion				
	Potential chemical spills (Emergency)		X				X		X						
Operation of Medical and Other Equipment	Energy usage		X	X						X (oil, natural gas)					
	Hazardous waste generation (batteries)						X		X	X (land)					
Compressed Gas Usage (oxygen, nitrous oxide, etc.)	Raw material usage (chemicals)								X		Resource Depletion				
	Possible Fire Hazard (Emergency)		X						X						
	Chemical Leakage (Emergency)		X				X		X						
Energy usage	Energy usage		X	X	X					X (oil, natural gas)					
Possible Fire Hazard (Emergency)	Possible Fire Hazard (Emergency)		X						X						
Possible Occupational Exposure to Radiation	Possible Occupational Exposure to Radiation								X						

Source: St. Mary's General Hospital, Ontario, January, 2001

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TABLE 3: SIGNIFICANT EVALUATION CRITERIA FOR ENVIRONMENTAL IMPACTS

Total Significance = Consequence x Frequency x Degree of Control

*Note: **Any Environmental Impact at or above 27 is "Significant."*

CRITERIA	*RANKING*	DESCRIPTION
Consequence The severity of an anticipated impact.	*Critical- 5*	Non-reversible, major environmental damage, **OR** the possibility of endangering human life.
	Major- 4	Major reversible environmental or human health (long term) damage, **OR** currently exceeds regulatory limits.
	Significant- 3 **	Moderate reversible environmental or human health (short-term) damage, legislative/regulatory/other requirements apply.
	Marginal- 2	Minimal loss to the environment, reversible, within regulatory limits.
	Negligible- 1	Insignificant effects on environment (i.e. nuisance, odor, noise, etc), within regulatory limits, **OR** no loss to the environment.
	Positive- 0	Positive Environmental Impact
Frequency The likelihood of the impact occurring.	*Frequent- 5*	Impact occurs continuously or in intervals throughout the day and/or night.
	Probable- 4	Impact is expected to occur at least once per day.
	*Possible- 3***	Impact is expected to occur occasionally (at least once per week or once per month.)
	Remote- 2	Impact is expected to occur at least once per year.
	Improbable- 1	Impact is unlikely to occur or is not expected to occur during the lifetime of the facility.
	Positive- 0	Positive Environmental Impact.
Degree of Control The amount of control the facility currently has over the occurrence of the impact.	*No Control- 5*	The facility has *zero* preventative measures in place.
	Minimal- 4	The facility has *minor* preventative measure in place.
	*Moderate- 3***	The facility has *some* preventative measures in place.
	High Level- 2	The facility has *numerous* preventative measures in place
	Full Control- 1	The facility has *extensive* preventative measures in place.
	Positive- 0	Positive Environmental Impact

Source: St. Mary's General Hospital, Ontario, January, 2001

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TOOL TO DETERMINE SIGNIFICANCE

List your top 5 aspects/impacts below. Rank them using the scale of 1-5, five being the most significant. Add the scores to get a first cut priority.

- **How to Prioritize? (ONE SUGGESTION for Scoring Guide)**

Scale	Scope	Severity	Cost	Compliance	Do-able	Occurrence of Impact
1	unnoticeable	no potential impact on health/environment	$0- 200	minimal	resources in-house	improbable / never
2	only one department	no actual impact on health/environment	$200-5,000	recordkeeping only, warning only	time available and budget planned	infrequent (<1/yr)
3	organization-wide	low impact on health/environment	$5,000-50,000	civil penalty: minor fine	time available	repeated (>1/yr but <1/mo)
4	outside the organization; local impact	significant damage to health/environment	$50,000-250,000	civil penalty: major fine	planning will be done	frequent (>1/mo)
5	outside the organization; regional impact	severe damage to health/environment	greater than $250,000	criminal penalty: striped suit	no planning done	continuous (on-going basis)

Aspect / Impact	Scope	Severity	Cost	Compliance	Do-able	Occurrence	Total

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ENVIRONMENTAL ASPECTS – LABORATORIES

DEPARTMENT: _____ **LAB SUPERVISOR:** _____

TYPE OF LAB: ❑ Chemistry ❑ Biological Sciences ❑ Medical Science

▪			❑
▪			❑
▪			❑
▪			❑
▪			❑
▪			❑

_____

Responsible Person

_____

Effective Date

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ENVIRONMENTAL ASPECTS AND IMPACTS: ENERGY USE EXAMPLE

Activity or Operation	Common Sources	Use Rate per Month (therms or kw/mo and $/mo)	Reduction Efforts
Computers/ Information Systems	❑ Personal Computers ❑ Servers ❑ Computer Lab Operation Overhead	156,250 kw/month $25,000 mo	☑ Auto-sleep mode ❑ Shut-down enforcement ☑ Lab Management
Heating and Cooling	❑ Air Conditioners ❑ Furnaces ❑ Fans ❑ Boilers and Water Heaters	390,625 kw/month $62,500 month	❑ System upgrades ❑ Insulation/windows ☑ Temperature Controls ☑ O&M BMP's
Lighting	❑ Offices/Admin Lighting ❑ Outdoor Lights ❑ Laboratories ❑ Operating rooms	312,500 kw/month $50,000 month	☑ Sensor Controls ❑ Delamping ☑ High efficiency bulbs ❑ Relamping ❑ Tandem wiring
Lab Equipment	❑ Spectrometers ❑ Ovens ❑ Hoods ❑ Cleaning Equipment ❑ Microscopes	109,375 kw/month $17,500	☑ O&M BMPs ❑ Technology upgrade
Refrigeration	❑ Food Service/Campus Dining ❑ Vending ❑ Laboratory Cooling Needs ❑ On-campus Commercial	234,375 kw/month $37,500 month	❑ Coil maintenance ☑ System upgrade ❑ O&M BMPs

_____

Responsible Person/Date

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ENVIRONMENTAL ASPECTS – JANITORIAL OPERATIONS

ACTIVITY OR OPERATION	COMMON CONCERNS	USE RATE PER MONTH	REDUCTION EFFORTS
BATHROOM CLEANING ✓ Toilet Bowl ✓ Cleaners ✓ Disinfectants	❑ Hydrochloric acid ❑ Phosphoric acid ❑ Sulfamic acid ❑ Other acid ❑ 2-Butoxy ethanol ❑ Isopropyl alcohol ❑ Other toxic ingredients4		❑ "Environmentally Preferable" Product1 ❑ Dilute ❑ Use Reduction and Minimization Method2 ❑ Other:_____
FLOOR CARE ✓ Carpet Cleaners ✓ Floor Finish ✓ Hard Floor Care	❑ Carcinogens / Neurotoxins ❑ Solvents ❑ VOC's ❑ Other toxic ingredients		❑ "Environmentally Preferable" Product ❑ Dilute ❑ Use Reduction and Minimization Method ❑ Other:_____
FIXTURE/FURNITURE CLEANING ✓ Furniture Polish ✓ Metal Cleaner ✓ General Purpose Cleaners	❑ 2-Butoxy ethanol ❑ Isopropyl alcohol ❑ Chlorinated solvents ❑ Hydrocarbon solvent ❑ Other toxic ingredients		❑ "Environmentally Preferable" Product ❑ Dilute ❑ Use Reduction and Minimization Method ❑ Other:_____

GLASS CLEANING o Glass Cleaners	❑ 2-Butoxy ethanol ❑ Isopropyl alcohol ❑ Other toxic ingredients		❑ "Environmentally Preferable" Product ❑ Dilute ❑ Use Reduction and Minimization Method ❑ Other:_____

Notes:
1. Environmental Preferable Product refers to an alternative product that eliminates or minimizes common chemicals of concern.
2. Minimize use of product by only using product when needed, rather than following predetermined schedule. Also, minimize exposure through use of personal protective equipment and/or alternative product forms (for example, trigger vs. aerosol container).
3. See Occupational Safety and Health Administration's website: http://www.osha-slc.gov/SLTC/carcinogens/index.html or U.S. Department of health Information Service National Toxicology Program's website: http://ehis, niehs.nih.gov/roc for listing of known carcinogens.
4. See the Janitorial Pollution Project's website for listing of potentially harmful chemicals: www.westP2net.org/janitorial/jp4.htm

_____

Responsible Person

_____

Effective Date

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Environmental Procedure

Procedure Number: **Effective Date:**
Title: Identification of Aspects, Determination of Significant Aspects, and Setting of Objectives and Targets
Authorized by:

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1. **PURPOSE:**

The purpose of this procedure is to determine the method by which aspects are identified and by which significant aspects are determined.

2. **ACTIVITIES AFFECTED:**

2.1 Cross Functional Team
2.2 Plant Operating Committee (OCM)
2.3 Internal Auditors

3. **FORMS USED:**

None.

4. **REFERENCES**

4.1 Aspects and Significant Aspects and Establishing Environmental Objectives and Targets
4.2 Environmental Regulations and Other Requirements – Obtaining and Maintaining information
4.3 External Communications
4.4 Internal Environmental Communications
4.5 Internal Environmental System Audits
4.6 Compliance Assurance
4.7 Responding to Community Complaints/Inquiries
4.8 Contractor Management
4.9 Aspects Database
4.10 Environmental Aspects Identification Worksheets

5. **DEFINITIONS:**

SARA – Superfund Amendment Reauthorization Act
- Tier II Reporting Levels (10,000 lb)
- Toxic Chemical Release Inventory Levels (25,000 lb manufactured, processed, 10,000 lb – otherwise used)

6. **EXCLUSIONS:**

None.

7. **PROCEDURE:**

7.1 Aspects will be identified, significance determined, and objectives and targets set following Aspects Procedure.

7.2 A Cross Functional Team (CFT), whose membership shall represent each functional activity of the facility, is responsible for the identification of aspects, the determination of significant aspects, and the setting of objectives and targets.

7.3 Aspects are identified by using Aspects Spreadsheets, expert knowledge, and interviews of functional areas.

7.4 Aspects encompass all functional areas whose activities, products, or services the plant can control or over which the facility can have influence.

7.5 Consideration of interested parties shall be utilized in the determination of significant aspects. Interested parties are defined as employees, customers, stockholders, agencies, business and residents adjacent to the facility. Views of interested parties are received through the external communications procedure, Responding to Community Complaints/Inquiries.

7.6 Legal and other requirements are considered to be significant.

7.7 Volumes of materials stored/consumed are considered significant when meeting SARA reporting.

7.8 Other criteria used for significance determination shall include but, not limited to, emission inventories, pollution prevention and waste minimization programs, property assessments, contractor activities, and environmental compliance audits.

7.9 Objectives and targets shall be established at each relevant functions and level within the plant organization.

7.10 Legal and other requirements, significant environmental impact, technology options, financial, operational, and business requirements shall be considered in setting of objectives and targets.

7.11 Objectives and targets shall be established for all significant aspects.

7.12 The aspects, significant aspects, and objectives and targets shall be summarized and presented at the Operating Committee Meeting (OCM) for review and concurrence.

8. **GENERAL RULES:**

Exceptions to the criteria listed in section 7, shall be justified and noted in the Aspects Database.

9. **ENVIRONMENTAL RECORDS:**

9.1 Completed Aspects Spreadsheets

9.2 Completed Aspects Database

10. **RECORD OF REVISIONS:**

Date:	Description:	Pages affected:	Authorized by:
	Converted into a procedural format	All	
	Reformat header and footer	All	
	Changes made to reflect Visteon		

SAMPLE HOSPITAL ENVIRONMENTAL PROCEDURE

Title: *EMS-4.3 PROCEDURE OBJECTIVES AND TARGETS*		
Document No: *EMS-4.3*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: *06/01/02*		
Next Revision Date: *06/03*		

1. Purpose

1.1 To describe the methods utilized by the hospital to identify environmental objectives and targets.

2. Scope

2.1 This policy governs the operations and programs conducted by [hospital name], located at [*insert hospital address*].

3. Responsibility

3.1 It is the responsibility of the EMS Representative and/or designate, in consultation with the Green Team, to ensure that environmental objectives, measurable targets are set on a regular basis.

3.2 It is the responsibility of the EMS Representative and/or designate to track environmental performance of the environmental objectives and targets, and to communicate progress to the Green Team, Senior Management Team and hospital staff.

3.3 It is the responsibility of the Senior Management Team to designate resources and staff to ensure that environmental objectives are met.

4. Procedure

4.0 Annually, the EMS Representative and/or designate, the Green Team and/or Senior Management (if objectives require actions that have a financial cost of >$1000.00) will set and approve environmental objectives and targets based on:

- the Environmental Policy (EMS- 4.2);
- significant Hospital Environmental Impacts (EMS-4.3.1);
- input from hospital staff, Senior Management and interested parties,
- changes in legal or other requirements (EMS- 4.3.2);
- compliance and other internal audit findings;
- environmental emergencies or incidents;
- technological options available; and
- financial and operational requirements.

The environmental targets must be S.M.A.R.T. (Specific, Measurable, Achievable, Results-oriented, and Time-dependant.)

4.2 The approved environmental objectives and targets will be documented on the "Objectives and Targets Chart" (Exhibit 1- EMS-4.3.3-1).

4.3 Refer to the Procedure for Environmental Management Program(s) (EMS-4.3.4) for the identification of actions to achieve designated environmental objectives and targets.

4.4 The EMS Representative and/or designate will communicate objectives and targets to the hospital staff via email, displays, environmental information sessions, and hospital orientation, on a regular basis.

4.5 The EMS Representative and/or designate monitors the progress of environmental objectives and targets in the through identifying performance indicators. Regular progress reports are presented to the Green Team during monthly meetings. Maintenance of data pertaining to progress of environmental objectives and environmental performance is outlined in the Procedure for Monitoring and Measurement (EMS- 4.5.1).

4.6 If at any time, the EMS Representative and/or designate, Green Team and/or Senior Management wishes to change, revise or alter the approved environmental objectives and targets to represent progress or lack thereof, the EMS Representative and/or designate will make the needed changes and send the resulting document back to the Green Team for approval.

4.7 Significant aspects and environmental issues not formally addressed through this procedure will be addressed/managed on a priority/as-needed basis by the EMS Representative and/or designate and the Green Team.

5. Definitions

5.1 Definitions relating to the content of the EMS are contained in the Glossary.

6. References

ISO 14001 - 96 - Environmental Management System Standard
EMS- 4.2 Environmental Policy
EMS- 4.3.1 Procedure for Environmental Aspects
EMS- 4.3.2 Procedure for Legal and Other Requirements
EMS- 4.3.4 Procedure for Environmental Management Program(s)
EMS- 4.4.7 Procedure for Emergency Preparedness and Response
EMS- 4.5.1 Procedure for Monitoring and Measurement
EMS- 4.5.3 Procedure for Records

7. Exhibits

Exhibit 1- EPPM-4.3.3-1, Objective and Targets Chart

SAMPLE HOSPITAL ENVIRONMENTAL PROCEDURE

Title: *EMS-4.3.4 PROCEDURE FOR ENVIRONMENTAL MANAGEMENT PROGRAMS*		
Document No: *EMS-4.3.4*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: *06/01/02*		
Next Revision Date: *06/03*		

1. Purpose

1.1 To ensure that a procedure is in place to establish and maintain Environmental Management Program(s) to achieve the identified objectives & targets.

2. Scope

2.1 This policy governs the operations and programs conducted by [hospital name], located at [*insert hospital address*].

3. Responsibility

3.1 It is the responsibility of the EMS Representative and/or designate, in consultation with the Green Team to develop, on a regular basis, Environmental Management Program(s) for each environmental objective and target.

3.2 It is the responsibility of the EMS Representative on behalf of the Green Team, to approve the Environmental Management Program(s) under $1000.00 and to designate appropriate resources and staff to ensure that these programs are implemented and maintained.

3.3 It is the responsibility of a representative from the Senior Management Team to comment and approve those Environmental Management Program action(s) that require $1,000.00 or more (capital) for implementation.

3.4 It is the responsibility of designated staff to follow through with the Environmental Management Program(s) and to track and report progress of activities to the EMS Representative and/or designate.

4. Procedure

4.1 Annually, the EMS Representative and/or designate, in consultation with the Green Team, will develop and set environmental objectives and targets as described in the Procedure for Objectives and Targets (EMS- 4.3.3).

4.2 The EMS Representative and/or designate, in consultation with the Green Team then develops and documents the “Environmental Management Program(s)” (Exhibit 1-EMS-4.3.4-1) for achieving the appointed environmental objectives and targets.

4.3 Environmental Management Program(s) must include (but is not limited to): actions for achieving the objective and target, responsible parties, the time-frame(s) for completion, and other stakeholder involvement.

4.4 A member of the Senior Management Team will review the Environmental Management Program(s) to ensure economic feasibility, appropriateness and to allocate adequate resources for implementation.

4.5 After inputting comments from the representative of the Senior Management Team, the EMS Representative approves the Environmental Management Program(s) for under $1000.00. The Senior Management Team approves all actions with a cost of $1000.00 or over (capital).

4.6 The EMS Representative and/or designate, Green Team members, and other designated personnel, will accomplish the duties set forth in the Environmental Management Program(s) in the time-frame determined.

4.7 The EMS Representative and/or designate monitors the progress of Environmental Management Program(s) and reports the progress of the program(s) to the Green Team, Senior Management, and hospital staff, on a regular basis. Maintenance of data pertaining to the progress of the Environmental Management Program(s) is outlined in the Procedure for Monitoring and Measurement (EMS- 4.5.1) and the Procedure for Records (EMS- 4.5.3).

4.8 If at any time, the EMS Representative and/or designate, members of the Senior Management Team and Green Team wishes to change, revise or alter the approved environmental management program(s) to represent progress or lack thereof, the EMS Representative and/or designate will make the needed changes and send the resulting document back to the Green Team for approval.

4.9 Upon completion of the Environmental Management Program(s), the EMS Representative and/or designate will review the overall effectiveness of the program(s) against the intended objective and target. If any issues or concerns arise, action plans may be developed to correct any deficiencies.

5. Definitions

5.1 Definitions relating to the content of the EMS are contained in the Glossary.

6. References

ISO 14001 - 96 - Environmental Management System Standard
EMS- 4.3.3 Procedure for Objectives and Targets
EMS- 4.5.1 Procedure for Monitoring and Measurement

EMS- 4.5.3 Procedure for Records

7. Exhibits

Exhibit 1- EMS-4.3.4-1, Environmental Management Program Chart

Environmental Review of Projects

1.0 Purpose/Scope

This procedure defines the method for identifying and evaluating the environmental issues of new projects at the [hospital name] to:

a) Ensure that appropriate consideration I given to environmental issues prior to project approval and funding;
b) Ensure that new environmental aspects generated by projects are identified and their significance evaluated; and,
c) Provide a mechanism for the amendment of environmental management system elements and programs, where relevant, to ensure that the environmental management system applies to such projects.

2.0 Activities Affected

All areas and departments

3.0 Forms Used

Project Environmental Checklist

4.0 References

EP-002 Environmental Aspect, Objectives and Targets and Management Programs

5.0 Definitions

None.

6.0 Exclusions

None

7.0 Procedure

7.1 Areas/departments initiate Project Appropriation Requests when needed for project funding becomes apparent.

7.2 The initiating activity or designee shall identify and evaluate environmental issues associated with the project. A summary of this evaluation shall be documented on a Project Environmental Checklist form and the form added to the Appropriation Request. This process may

be undertaken in liaison with the Environmental Coordinator (or other competent individual) at the discretion of the initiating activity, and shall include an identification of environmental aspects, and requirements for obtaining approvals from environmental regulatory agencies.

7.3 The initiating activity shall submit the Appropriation Request and complete Project Environmental Checklist for review to the Environmental Management Representative.

7.4 The Environmental Management Representative, or designee, shall review the proposed project to ensure that all relevant environmental issues have been identified, and if incomplete shall return the Appropriation Request and Project Environmental Checklist to the initiating activity for alteration.

7.5 The Environmental Management Representative, or designee, shall review the environmental aspects of the project, considering their significant in line with EP-002.

7.6 Following appropriate review, the Environmental Management Representative or designee may approve the project by returning the Appropriation Request to the initiating activity for further processing. If a project is not acceptable, the initiating activity will coordinate any necessary actions to satisfy concerns identified. The initiating activity in conjunction with the Environmental Management Representative or designee will coordinate any necessary prevention, mitigation or control activities associated with the project.

8.0 General Rules

8.1 Environmental aspects associated with projects shall be evaluated for significance by the Cross Functional Team per EP-002.

8.2 Changes to the Environmental Management System resulting from an environmental review of a project will be approved by the Facility/Plant Management Team.

9.0 Records

Records shall be retained consistent with EP-013.

Record of Revisions

Revision Date	Description	Sections Affected

[Hospital Name]

Project Environmental Checklist

Project Description:

Project Number:

AIR EMISSIONS	**Yes**	**No**
Will this project/process change produce air emissions?		
Will this project/process change an air permit or permit modification?		
Does the change require air pollution controls?		
Does the project/process change require the use or purchase of ozone depleting substances?		

WATER DISCHARGES	**Yes**	**No**
Does the project/process change results in a wastewater, sanitary or storm water discharges?		
Will the project/process change result in changes to water discharge flow rates?		
Will the discharge require a permit modification?		
Will new or additional pretreatment be required?		
Are facility discharges to a common sewer altered?		

STORAGE TANKS	**Yes**	**No**
Will underground storage tanks be installed?		
Will tanks be installed to store hazardous waste or materials, petroleum products or propane?		

WASTE GENERATION	**Yes**	**No**
Will the project/process change produce a waste or recyclable material?		
Will the waste be classified as special or hazardous?		
Will off-site disposal be required?		
Are special handling, abatement or disposal measures required?		

ENERGY USE	**Yes**	**No**
Will the project/process change effect facility energy usage?		

OTHER CONSIDERATIONS

	Yes	No
Do recycling options and costs need to be considered?		
Does the project/process change require use of toxic, hazardous or carcinogenic materials?		
Do project/process materials require special handling or storage?		
Does the project cause land disturbances?		
Do pollution prevention issues need to be addressed?		

	Yes	No
Does the project/process change impact the surrounding community (i.e., odor, noise etc.)?		
Are there any wildlife or land use issues?		
Does the project/process change alter or add to current facility aspects?		
Do the project/process change require a change to Emergency Response methods?		

_____ _____

Initiating Activity Manager Date

_____ _____

Environmental Management Representative Date

[hospital name]	EMS Procedure	2.3
	Effective Date	
	Subject	**Objectives and Targets**

Purpose This procedure is used to (1) develop and update the EMS objectives and targets and (2) create action plans for achieving the objectives.

Step 1 The EMS Manager and EMS Participants are responsible for developing the EMS objectives and targets. Similar to the aspects and impacts review, the EMS Manager solicits input from [hospital name] departmental staff to ensure that objectives and target are realistic and achievable.

Objectives are goals that are consistent with the organization's environmental policy, priority environmental aspects, and applicable environmental regulations.

Targets detailed performance goals related to, and supporting a specific objective. Targets should be quantitative, realistic, linked to a source, measurable, and related to a baseline and normalization metric.

Step 2 Objectives and targets will be linked to significant environmental aspects and compliance issues identified by EMS Procedures 2.1 and 2.2, respectively.

Step 3 An action plan will be developed for each objective. Each action plan will describe specific actions needed to achieve the objective, the resources needed for each action, the person responsible for each action, and deadlines.

Step 4 Progress in achieving EMS objectives and targets will be tracked according to procedures described in Element 4.1, Measurement and Monitoring.

Step 5 On a monthly basis, the EMS Manager and other [hospital name] departmental and facility staff will (1) review objectives, (2) discuss the impact of corrective and preventive actions on objectives and targets, (3) determine whether existing objectives should be modified based on experience from the action plan and (4) develop new EMS objectives when existing objectives are met.

Step 6 Every 6 months, the EMS Manager will prepare a status report of progress against objectives and targets for the [hospital name] administration for review and input.

Step 7 Objective and target documentation will be retained for at least 2 years.

Additional System Examples

[Hospital Name]
Environmental Aspects, Objectives & Targets Determination

Form Completed by: _____ Date Completed: _____
Department/Area: _____ Process/Activity: _____

Aspect Identification		Significance		Objectives & Targets	
Category*/Aspect	Quantity/Volume	Rationale for Significance/ Non-Significance**	S/NS***	Objective	Target

*Aspect Categories: Air Emissions, Wastewater Discharges, Liquid & Solid Wastes, Energy Use, Storm Water Discharge, Water Use, Storage Tanks, Material Usage, Noise Odor, Natural Environment, Land Condition
**Rationale for Significance/Non-Significance: R=Regulated/Other Req., A=Accidental Release, E=Energy, L=Environmental Load, NS=Doe not meet significance criteria.
***Abbreviations: S=Significant & NS=Not Significant

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[Hospital Name]
Environmental Management Programs

Significant Aspect:
Department/Area(s):
Objective:
Date:
Program Plan:

Program Leader:
Process/Activity:
Target:

Task	Responsible Party	Schedule	Performance Monitoring	Key Characteristics/Operational Control/Comments

Action Plan for EMS Objective and Target

OBJECTIVE: _____

TARGETS: _____

BASELINE: _____

ASPECT(S): _____

Parameter	Measurement Frequency

OPERATION(S) THAT ARE SOURCE(S) OF ASPECTS ADDRESSED: _____

_____

_____

ACTIONS PLANNED AND TAKEN TO ACHIEVE OBJECTIVE

Consider what type of actions you are evaluating to achieve objectives and targets. Are there pollution prevention alternatives such as source reduction, materials substitution, in-process recycling, or waste minimization that could achieve your objectives and targets? Try to find an action that addressed the source most directly.

Action 1: _____

_____

Resources Needed: _____

Deadline: _____ Responsible Person: _____

Action Taken: _____

_____

Action 2: _____

_____

Resources Needed: _____

Deadline: _____ Responsible Person: _____

Action Taken: _____

_____

_____

Responsible Person:

_____

Effective Date:

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OPERATIONAL CONTROL EXAMPLES:

Title: *Diesel Generator Inspection & Testing Procedure*		
Document No: *Eng-001*	**Prepared By:** *Maintenance, Engineering Services*	**Approved By:** *Director, Engineering Services*
Date Approved: *03/20/02*		
Next Revision Date: *03/03*		

PURPOSE:

To ensure the diesel generator is in proper working order, tested and inspected regularly in order to provide back-up power for the hospital.

PROCEDURE:

1. The diesel generator must be tested every week for a maximum of 0.5 hours to ensure the machinery is in proper working order.

2. Inform Switchboard Operators of testing prior to performing any tests.

3. Perform following testing perimeters on a weekly basis:

3.1 Pre-Checks of Diesel Generator:

a) Perform pre-checks & record levels:

- oil level
- coolant level
- battery electrolite level
- battery electrolite level
- block heater
- dip day tank

3.2 Starting Diesel Generator:

a) In Lower Powerhouse (transfer switch area) perform:

- lamp tests,
- turn control switch to "Test" position to start diesel generator, and
- reset any resulting alarms.

3.3 Running Tests of Diesel Generator:

a) Once diesel generator is running perform running checks of the louvres and battery charger and record the following:

- starts,
- lube oil pressure,
- lube oil temperature,
- coolant temperature,
- RPM,
- percentage load,
- battery voltage (during test),

- generator voltage phases 1, 2 & 3,
- generator amperage phases 1, 2 & 3, and
- frequency.

b) After performing running checks, proceed back to lower powerhouse (transfer switch) and record:

- normal power voltage phases 1, 2,& 3,
- normal power frequency,
- emergency power voltage phases 1, 2 & 3, and
- emergency power frequency.

3.4 Shutting Down Diesel Generator Tests:

a) Prior to the 30 minute mark, turn the control switch to the "Auto" position (machine will run for 5 minutes before it transfers back to normal operating power.) Wait for power to transfer.

b) Reset any power alarms that may have gone off.

3.5 Aboveground Storage Tanks:

a) Dip aboveground storage tank(s) and record level(s).
b) Visually observe and record condition of tank(s) (i.e. rusting, leakage, other abnormalities).
c) Ensure all other safety features are working properly.

Title: *Safe Storage of Compressed Gas Cylinders*		
Document No: HS-*001*	**Prepared By:** *Health and Safety Specialist*	**Approved By:** *Director, Human Resources*
Date Approved: *03/20/02*		
Next Revision Date: *03/03*		

PROCEDURE:

1. Proper Storage:

1.1. Store cylinders in a well ventilated area.

1.2. Store cylinders away from fire risk and away from sources of heat or ignition. Mark the area "No Smoking".

1.3. Store cylinders upright, on a firm, level, well-drained surface, and secure cylinder (with chains) to prevent from falling.

1.4. Store nothing else in the cylinder storage area. In particular avoid oil, paint or corrosive or flammable liquids.

1.5. Segregate full and empty cylinders.

1.6. Segregate cylinders in the storage area according to gas type (i.e. flammable, inert, oxidizing, toxic, etc.)

1.7. Cylinders containing oxygen or oxidizing gases must be separated from cylinders containing flammable gases by minimum 3 meters or by a fire resistant partition.

1.8. Cylinders containing inert gases may be stored with cylinders containing oxygen or oxidizing gases.

1.9. Toxic or corrosive gas cylinders must be stored separately from ALL other gas cylinders. Follow the instructions on the gas Material Safety Data Sheet.

1.10. Propane or butane cylinders must be stored a minimum of 3 meters away from ANY other gas cylinder type.

2. Transportation To and From Departments

2.1. Move one tank at a time for transporting to and from department(s).

2.2 Ensure tanks are tied to wall when they reach their destination points.

Title: *Mercury Spill Clean-Up & Disposal*		
Document No: HS-*001*	**Prepared By:** *Supervisor, Housekeeping and CSR*	**Approved By:** *Environment, Health and Safety Specialist*
Date Approved: *03/20/02*		
Next Revision Date: *03/03*		

PURPOSE:
To ensure that Mercury spills are cleaned-up properly and promptly and disposed of in accordance with applicable legislations.

POLICY STATEMENT:
The hospital is committed to the to the immediate reduction and eventual elimination of mercury.

PROCEDURE:

1. Clean-Up

1. In case of a large uncontained mercury spill call a "Code Brown" (procedure found in hospital policy and procedure manual.

2. For a small contained mercury spill, secure spilled area and immedietley obtain the "Mercury Spill Kit" and a full-faced respirator (with mercury cartridges) from the hospital spill kit in the Housekeeping Department (Room #121).

   NOTE: Only those individuals who have recieved fit-testing and fit-checking training are to use the respirators. If you have not recieved training call an Environmental Services personnel.

3. In all cases wear gloves and a full-face respirator when treating mercury spills.

4. Block the area from foot traffic for a large radius (minimum 6-foot radius) around the centre of the spill site.

5. Check clothing, footwear, bedding, etc. for mercury and mercury debris. Remove contaiminated clothing, footwear, etc. and place at the edge of the spill site.

6. Collect and treat any visible and collectible mercury using VYTAC MIS from Mercury Spill Kit.

7. Wet the MIS with a water spray and aggitate the mixture with a stirring stick or similar tool to assure that all the mercury is in contact with MIS. In less then a minute all the mercury should be amalgamated and solidified. If drops of liquid mercury remain, add more MIS and repeat the procedure until all the mercury is solidified.

   Note: It will require approx. 120-150 grams of MIS to treat 100 grams (only 8 ml) of mercury.

8. The solidified amalgam is safe to collect using the brush and dust pan that is provided in the Mercury Spill Kit. The collected residue should be placed in a closed plastic container and clearly marked as "containing mercury".

9. Store the bucket the hospital's Flammable Storage Room for disposal by a licensed hazardous waste company.

8. Apply VYTAC MVS to all areas that might be contaminated with mercury particles. Make sure that crevices, cracks and inaccessible areas are covered. For maximum vapour suppression it is recommended that a 3-5 mm coverage be applied.

   (NOTE: MSV should only be regarded as a temporary solution.)

9. MSV will immediately suppress any further generation of vapours. Remove at the earliest convenience. Contaminated residues should be collected by either sweeping up or the use of a high filration (HEPA) vacuum which is available through Engineering Services. The residue contains mercury and should be diposed of in the same sealed plastic container. MSV darkens as it becomes contaminated with mercury, indicating its presence.

10. If visible mercury is coated with MSV it can be treated using MIS, following standard procedures. Caution: A slight hydrogen sulphide odour may develop during the neutralization process.

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Sample Letter Requesting Certificate of Analysis and Sample Certificate of Analysis

[Insert Hospital Name]

January 2, 2002

Name
Vendor Name
And Address

Subject: Certificate of Analysis

Dear Ms. Smith:

As you are aware, mercury is of increasing concern as an environmental pollutant. Mercury released from air and water sources is transformed into methlymercury in lakes and rivers. The methlmercury bioaccumalates in the aquatic food chain making consumption of fish hazardous to those organisms high on the food chain. As a result, regulations on the discharge of mercury to the solid and wastewater are becoming increasingly stringent.

Because of this knowledge, and our concern for the environment, our institution has instituted a mercury reduction policy. This policy requires the elimination or minimization of mercury in all of our purchases. Low level concentrations of mercury in products (less than 10,000 ppm or one percent) are not required to be listed on Material Safety Data Sheets. The contribution from the sum of these low concentration sources accounts for a large fraction of the mercury in the wastewater stream. In order for our purchasing department to be able to make an informed choice on mercury concentration within the products that it buys, we are requesting that all vendors supply us with a certificate of analysis and/or a notarized affidavit which describes product mercury concentration and the detection method used in the analysis. This information will be used along with other criteria in the selection process of our vendors.

Please submit the aforementioned information on all products that you intend to supply our institution. Thank you for your understanding and assistance in this matter.

Sincerely,

Jane/John Smith
Purchasing

Anderson's Acids
98 Molarity Drive
Marathon, Ontario
H2S 04 Canada

Customer: [insert hospital name]

Attn: Jane/John Smith
Fax: 1-800-555-5555

Product Grade:	SULFURIC ACID 93%	Shipment Date:	
B/L Number: 00008650		Quantity (as is):	100.400 T
Customer P/O No.: C125062			
Routing:	ONR-HEARST-ACSSTMA-WCSUPER-BN-CLOQ-DNE		
Tank Car/Tank Truck No.: UTLX125021			

The analysis below is representative of the quality of product loaded into the above shipment.

Parameter	Analysis	Specification
Strength (%H2S04)	93.67	93.19 Min
Color (HU)	11	40 MAX
Iron (ppm Fe)	9	50 MAX
Sulfur Dioxide (ppm S02)	10	50 MAX
Appearance (%T)	100	
Oxides of Nitrogen (ppm NO3)	1	10 MAX
POM (ml 0.02N KMn04)	1.00	5.00 MAX
Mercury (ppb)	60	

Detection method for mercury analysis _____

ANALYST:

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Vendor Product Mercury – Content Disclosure

Hospital name _____

Name of Hospital Purchasing Agent _____

Address _____

_____

Telephone _____ Fax _____

Our hospital has the policy of minimizing the use of mercury in products purchased for the hospital. Such products may include:

Barometers	Lamps
Batteries	Pharmaceutical products
Cleansers and soaps	Sphygmomanometers
Electrical relays	Switches
Gastrointestinal tubes	Thermometers
Laboratory chemicals	Thermostat probes
Laboratory manometers	Thermostats

Vendor name _____

Name of vendor's agent _____

Address _____

_____

Telephone _____ Fax _____

The above-named vendor agrees to:

- Assist _____ Hospital in obtaining manufactures' disclosures about the mercury content of their products.

- Assist _____ Hospital in selecting products that are virtually free of mercury content.

_____ _____

Signature of vendor's agent Date

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SAMPLE HOSPITAL ENVIRONMENTAL PROCEDURE

Title: *EMS-4.5.1 PROCEDURE FOR MONITORING AND MEASURMENT*		
Document No: *EMS-4.5.1*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: *06/17/02*		
Next Revision Date: *06/03*		

1. Purpose

1.1 To ensure that the key characteristics of the hospital's operations and activities that can have a significant impact on the environment are tracked and measured, on a regular basis, to ensure environmental compliance and to provide a basis for environmental performance.

2. Scope

2.1 This policy governs the operations and programs conducted by [hospital name], located at [*insert hospital address*].

3. Definitions

3.1 Definitions relating to the content of the EMS are contained in the Glossary.

4. Responsibility

4.1 The EMS Representative and/or designate is responsible for establishing and maintaining the monitoring database on a regular basis.

4.2 Department Managers/Supervisors are responsible for ensuring that regular monitoring of key characteristics of their departments operations are monitored and documentation is maintained

5. Procedure

5.1 Compliance

5.1.1 An Environmental Compliance Audit will be conducted by the hospital at a minimum of every 3 years using the hospital's subscription compliance software program or by an outside consulting firm, to assess regulatory compliance issues relating to all "significant environmental aspects" and issues identified in previous audits, inspections, and assessments.

5.1.2 Monthly workplace safety inspections performed by the members of the Health and Safety Committee will identify hazards that may have the potential to have negative environmental impacts. The members of the HSC performing the monthly inspections will relay this information to the EMS Representative through monthly reports/meetings.

5.2 Control of Monitoring and Measurement Equipment

5.2.1 Any equipment used to measure and monitor key characteristics of the environmental management system is maintained in order to provide confidence in the accuracy of the measurements. The following outlines the components of the system designed to provide that confidence.

5.2.2 Department Managers/Supervisors inform the EMS Representative and/or designate when new measuring and monitoring equipment has been purchased in their departments. The EMS Representative and/or designate enters the information into the "Monitoring and Measurement Documentation Chart" (Exhibit 1- EMS-4.5.1-1).

5.2.3 Operating procedures relating to the calibration and monitoring processes of departmental equipment are developed and maintained by the Department Managers/Supervisors and/or designates.

5.2.4 Trained individuals within each department, Engineering Services personnel and/or external companies, perform the calibration of hospital monitoring equipment. Hospital equipment calibrated by Engineering Services is included in the preventive maintenance computer program in Engineering Services.

Work orders are printed and performed based on the frequency of calibration for each piece of equipment entered into the system (frequency based on manufacturers guidelines and/or vendor's recommendations). Records of calibration are placed on, or in a close proximity to, the piece of equipment undergoing calibration testing and/or are kept by the external company performing the regular calibration of equipment.

5.2.5 The EMS Representative and/or designate periodically reviews the calibration records, to ensure that the operations are being performed as scheduled. If not, the EMS Representative will notify the department, individual, and/or Engineering Services to request that it be done.

5.3 Monitoring of Environmental Performance Indicators

5.3.1 The EMS Representative and/or designate will compile, on a regular basis, data required for ensuring objectives and targets are met in the Environmental Performance Indicator Binder.

5.3.2 Data relating to, and/or location of data relating to the key characteristics of the facilities operations are documented in the Environmental Performance Indicators Binder.

6. References

ISO 14001 - 96 - Environmental Management System Standard

7. Exhibits

Exhibit 1- EMS- 4.5.1-1 Monitoring and Measurement Documentation Chart

[Hospital Name]	EMS Procedure	4.1
	Effective Date	
	Subject	**Measurement and Monitoring**

Purpose This procedure is used to implement a measurement and monitoring program designed to support the EMS and specific EMS objectives and targets.

Step 1 The EMS Manager and EMS Team will track hospital metrics by collecting and charting data relevant to the metric, including those identified below.

Facility	Data Collection Frequency	Responsibility
Energy Use		
Water Use		
Laboratory Hazardous Wastes		
Janitorial Chemicals		
Computer/IT Wastes		
Construction and Renovation-associated Wastes		
Vehicle Fuel Chemical Use		

Step 2 The EMS Manager and EMS Team will identify and measure unique parameters for each EMS objective and target.

Step 3 The EMS Manager and EMS Team will measure, monitor, and record target-specific parameters at a predetermined frequency.

Step 4 The EMS Manager and EMS Team will review campus and target-specific measurement and monitoring data every 3 months to identify trends, evaluate progress toward meeting EMS objectives and targets, and discuss overall environmental performance.

Responsible Person:_____

Signature and Date:_____

[Hospital Name] Environmental Procedure

Procedure Number: **Effective Date:**
Title: Monitoring and Measuring

1. **PURPOSE:**

This procedure defines the mechanism and requirements for verification of measurement and testing equipment used to monitor and control significant environmental aspects.

2. **ACTIVITIES AFFECTED:**

Plant-wide.

3. **FORMS USED:**

None.

4. **REFERENCES:**

4.1 Environmental and Energy Reports
4.2 Air Emissions Management
4.3 Significant environmental aspects
4.4 Calibration matrix of key activities
4.5 Agency Reporting
4.6 Internal Environmental System Audits

5. **DEFINITIONS:**

None.

6. **EXCLUSIONS:**

None.

7. **PROCEDURE:**

7.1 The hospital shall identify and list measuring and testing equipment deemed necessary to monitor and control significant environmental aspects for permitted sources and other appropriate equipment.

7.2 The list should include definition of the characteristics, frequencies, and location of the equipment requiring calibration. Verification will be maintained in the using department. All equipment not owned by [hospital name], such as utility meters, will be calibrated and maintained by the owner.

7.3 Approved outside testing organizations may be used to verify measuring and testing equipment at a prescribed interval.

7.4 All other applicable measuring and testing equipment shall be maintained and verified by plant personnel according to manufacturer's recommendations.

7.5 The department manager or designee is responsible for maintaining lists, and verification and maintenance records (if any) for equipment in this area.

7.6 Any deviations from the proper operation or verification of measuring and testing equipment shall be reported to the department supervisor and/or the Environmental Control Specialist for the appropriate actions to be taken.

8. **GENERAL RULES:**

Deviations from procedures which affect environmental compliance shall be reported immediately to the Environmental Control Specialist.

9. **ENVIRONMENTAL RECORDS:**

Calibration Documentation

10. **RECORS OF REVISIONS:**

Date:	Description:	Pages affected:	Authorized by:
	Reformed & add new references for calibration & measurable	All	
	Changes made to reflect division staff recommendations	All	

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SAMPLE HOSPITAL ENVIRONMENTAL PROCEDURE

Title: *CALIBRATION AND MAINTENANCE OF MONITORING EQUIPMENT*		
Document No: *001*	**Prepared By:** *EMS Representative*	**Approved By:** *Management Representative*
Date Approved: *06/01/02*		
Next Revision Date: *06/03*		

1. Purpose

1.1 This procedure defines the mechanism and requirements for verification of measurement and testing equipment used to monitor and control significant environmental aspects.

2. Scope

2.1 This policy applies to associated operations and activities conducted by *[hospital name]*, located at [*insert hospital address*].

3. Responsibility

N/A

4. Procedure

4.1 The hospital shall identify and list measuring and testing equipment deemed necessary to monitor and control significant environmental aspects for permitted sources and other appropriate equipment.

4.2 The list should include definition of the characteristics, frequencies, and location of the equipment requiring calibration. Verification will be maintained in the using department. All equipment not owned by *[hospital name]*, such as utility meters, will be calibrated and maintained by the owner.

4.3 Approved outside testing organizations may be used to verify measuring and testing equipment at a prescribed interval.

4.4 All other applicable measuring and testing equipment shall be maintained and verified by facilities personnel according to manufacturer's recommendations/guidelines.

4.5 The Department Manager/Supervisor or designee is responsible for maintaining lists, and verification and maintenance records (if any) for equipment in this area.

4.6 Any deviations from the proper operation or verification of measuring and testing equipment shall be reported to the department Manager/Supervisor and/or the EMS Representative for the appropriate actions to be taken.

4.7 Deviations from procedures which affect environmental compliance shall be reported immediately to the EMS Representative.

5. Definitions

N/A

6. References

ISO 14001 - 96 - Environmental Management System Standard
Environmental and Energy Reports
Air Emissions Management
Significant Environmental Aspects
Calibration Matrix of Key Activities
Agency Reporting
Internal Environmental System Audits

7. Exhibits

N/A

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SAMPLE HOSPITAL ENVIRONMENTAL PROCEDURE

Title: *PROCEDURE FOR EMS AUDITS*		
Document No: *EMS-4.5.4*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: *07/11/02*		
Next Revision Date: *07/03*		

1. Purpose

1.1 To ensure that the EMS is periodically audited in order to determine if it conforms to the ISO 14001-96 Standard, and has been properly implemented and maintained.

2. Scope

2.1 This policy applies to all EMS related documentation associated with the operations and activities conducted by *[hospital name]*, located at [*insert hospital address*].

3. Responsibility

3.1 It is the responsibility of the EMS Representative to lead the EMS Internal Audit Team in the auditing process and ensure that audits are conducted on a regular basis.

3.3 It is the responsibility of the EMS Internal Audit Team to, on a regular basis, participate in the EMS auditing process.

4. Procedure

4.1 The EMS Representative and/or designate will lead a 2-3 member EMS Internal Auditing Team in conducting an Environmental Management System Audit annually using the "EMS Audit Checklist" (Appendix B) as a guideline.

Refer to the EMS Internal Auditing Team's Terms of Reference (EMS-4.5.4-1) on the Meditech system, for specific team and audit report requirements.

4.2 The audit scope will consist of all activities, operations and programs within the physical boundaries of *[insert hospital name and location]*. Audit plans will depend on results of previous audits and areas of "importance" identified by the lead auditor.

4.3 Prior to performing an EMS audit, each member of the EMS Internal Audit Team will review the current inventory of environmental aspects and impacts, findings and conclusions from the previous EMS audits, and other relevant EMS documentation.

4.4 Any non-conformances cited by the EMS Internal Audit Team will evoke the Procedure for Non-conformances, Corrective & Preventive Action (EMS-4.5.2).

4.5 The EMS Internal Audit Team will be responsible for producing an EMS Audit Report, with corrective action plans, as directed by the lead auditor.

4.6 The audit reports are forwarded the EMS Management Representative for review and final approval. He/She allocates resources as required for corrective/preventive actions.

5. Definitions

5.1 Definitions relating to the content of the EMS are contained in the Glossary.

6. References

ISO 14001 - 96 - Environmental Management System Standard
Appendix 1- EMS Audit Checklist

7. Exhibits

N/A

ISO 14001 Procedure – Element 4.5.4 – Environmental Management System Audit

Issue Date –
Revision No. 1

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1. Purpose: To ensure that the organization is conforming to the environmental management system and to ensure that the system has been properly implemented and is being maintained.

2. Scope: This procedure is for periodic environmental management systems audits to determine whether the system conforms to the requirements of the standard, that it has been properly implemented and maintained and provides information of the results of audits to the management.

3. General: Audits are required so that the organization can demonstrate conformance to the ISO 14001 standard. The audit programme should cover the following areas:

   - The activities and areas to be considered in audits
   - The frequency of audits
   - The responsibilities with managing and conducting audits
   - The communication of audit results
   - Auditor competence

4. Responsibility: The Environmental Manager is responsible for ensuring that the Audits of the environmental management system are conducted.

5. Procedure: Development of Audit Programme

   i. The Environmental Manager shall prepare an Audit Programme including a checklist of items to be audited.

   Frequency of Audits

   i. The Environmental Manager shall conduct an internal audit of the environmental management system annually.
   ii. The Environmental Manager shall arrange for an outside auditor to conduct an audit of the environmental management system every three years.
   iii. The Environmental Manager shall ensure that the outside auditor is competent to complete the audit.

   Audit Responsibilities

   i. The Environmental Manager is responsible for summarizing and communicating the results of the audit to the Plant Manager.
   ii. The Environmental Manager is responsible for identifying action items from the audit and notifying the appropriate Department Mangers of the action items.

iii. The Department Managers are responsible for resolving/rectifying action items in their department. Where the Department does not have sufficient resources to rectify the item, the Department Manager must inform the Plant Manger.
iv. The allocation of additional resources is at the discretion of the Plant Manger.

Communication of Audit Findings

i. The Environmental Manger shall identify all sensitive audit findings as "confidential". The dissemination of this information will be restricted to those involved in the rectification of the problem.

6. Related Records: Schedule 4.5.4a – Audit Programme Checklist
Schedule 4.5.4b – Tracking of Action Items
Annual Audits
Summary of Annual Audits

7. Approval

_____
Environmental Manager

_____
Date

Next Revision:
Revision Schedule:
Document Locations:

Author:
Reviewed by:

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SAMPLE HOSPITAL ENVIRONMENTAL PROCEDURE

Title: *EMS-4.4.7 PROCEDURE FOR EMERGENCY PREPAREDNESS AND RESPONSE*		
Document No: *EMS-4.4.7*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: *06/12/02*		
Next Revision Date: *06/03*		

1. Purpose

1.1 To ensure that this procedure and any environmentally related emergency procedures are reviewed and tested on a regular basis, to ensure their accuracy and effectiveness.

1.2 To establish and maintain procedures to identify potential environmental accidents and/or emergency situations and the appropriate response requirements.

1.3 To prevent and mitigate the environmental impact(s) associated with an accident and/or an emergency situation.

2. Scope

2.1 This procedure applies to all potential environmental accidents and/or emergency situations associated with all operations and programs conducted by [*insert hospital name*], located at [*insert hospital address*].

3. Definitions

3.1 Definitions relating to the content of the EMS are contained in the Glossary.

4. Responsibility

4.1 It is the responsibility of the EMS Representative and/or designate, in association with the Green Team and the hospital's Code/Emergency review committee to identify and/or review potential environmental accidents or emergency situations through the annual review of environmental aspects and impacts.

4.2 It is the responsibility of the hospital's Code/Emergency review committee to approve, review, and test all emergency preparedness procedures.

5. Procedure

5.1 Identification of Potential Environmental Accidents and/or Emergency Situations

5.1.1The EMS Representative and/or designate, in consultation with the Green Team and the hospital's Code/ Emergency review committee, identifies and documents all potential environmental accidents and/or emergencies associated with hospital operations and programs in the "Emergency Preparedness & Response Chart" (Exhibit 1- EMS-4.4.7-1). Possible emergency situations are also identified when developing the hospital's environmental aspects inventory.

5.1.2 At any time, a hospital employee can identify the potential for an environmental accident and/or emergency. He/She must complete a hospital "Employee Incident Report", clearly stating that this is a "potential" incident and/or hazardous situation. (See Hospital's procedure for Employee Incident Reporting.)

5.1.3 The Occupational Health Center/Health and Safety Department forwards a copy of the

Employee Incident Report(s) to the EMS Representative and/or designate for his/her review and records.

5.1.4 If the identified potential environmental accident and/or emergency has not been previously identified in the environmental aspects inventory or the "Emergency Preparedness & Response Chart", the EMS Representative and/or designate will add it to the charts.

5.1.5 The EMS Representative and/or designate must relay any information about any corrective and/or preventive actions taken to remediate the concern to the initiating employee within 2 weeks of action.

5.1.6 The EMS Representative and/or designate will accompany, on a regular basis, the Joint Occupational Health & Safety Committee members on their monthly inspections, to identify the potential for any new environmental accidents or incidents.

5.2 Emergency Preparedness and Response Procedures

5.2.1 Environmental emergency procedures, such as the hospital's emergency Code system, are reviewed and tested on a regular basis by the hospital's Code/emergency review committee.

5.2.3 The hospital's Code/emergency review committee reviews and will periodically test the Code procedures by performing "Drills", in order to ensure the effectiveness and accuracy of the procedure.

5.2.4 The hospital's Code/emergency review committee will review the code procedures after the occurrence of an environmental emergency or accident where the procedure was utilized, to identify any discrepancies

6. References

ISO 14001 - 96 - Environmental Management System Standard
Exhibit 2- EMS- 4.3.1-2 Environmental Aspects and Impacts Chart
[List Hospital Emergency Codes]

7. Exhibits

Exhibit 1- EMS- 4.4.7-1 Emergency Preparedness & Response Chart

Mercury Spill Clean-Up Procedures

Broken Thermometers: (There is not enough mercury involved to present a hazard; you do not need to respond with a vacuum.)

1. Using two 3"x5" cards push mercury into a pile.
2. Draw up into a syringe (no needle) and place in a sealed container or scoop onto a specimen container or other sealed container.
3. Disposal:
   Non-patient area: Fill out a hazardous waste tag and call the Hazardous Waste Management Unit for pick up.
   Patient are: Label container (mercury) and place on cart to bee returned to Sterile Supply.

Broken Manometers:

SMH patient area: Call should be referred to SMH Housekeeping.
Other area: Contact an Industrial Hygienist for immediate clean up.

**Note: Any call which sounds unusual (i.e. spilled on patient, on carpet, in toilet, not a thermometer or manometer) should be referred to an Industrial Hygienist.

It is important to respond as soon as possible (within 1 or 2 hours) to clean up any spill.

1. Make sure everyone is removed from the room (patient(s), visitors, staff).
   Patient bed should not be removed from the room.

2. Gather equipment
   - Mercury vacuum* and attachments (stored in the SMH Housekeeping Office- If locked have one of the supervisors paged)
   - The mercury vacuum is designed to clean up liquid mercury spills. Regular vacuum cleaners can volatilize the mercury and below the mercury vapors into the air. An activated carbon filter in this vacuum will absorb and contain the mercury vapors.
   - Toolbox. The following items should be in the tool box:
     - Flashlight
     - Screwdriver
     - Putty knife
     - Mercury holding jar
     - Respirator (3M 9908 Duct/Mist Respirator)
     - Yellow or pink wash basin (from clean utility room on unit)
     - Heavy plastic bag
3. Before entering room put on protective equipment.
   - Respirator
   - Long sleeve shirt
   - Long pants
   - Disposable gloves
   - Remove all jewelry

4. Assess the extent of the spill. Upon entering the room use flashlight (hold angled at floor level, put head close to floor to see where mercury is located). Also check wall, bed frame and mattress. Do not walk in contaminated areas.

If there is anything unusual about the spill (i.e. on carpet, in a toilet, on patient, etc.) a member of the Industrial Hygiene Unit should be consulted.

5. Set up mercury vacuum using the following steps:
   A. Place plastic dishpan under separator.
   B. Remove red cap off mercury separator and screw jar onto vacuum.
   C. Remove red end cap from hose.
   D. Place required attachment on hose.

6. Begin vacuuming at outer edges of spill and work towards center of spill (usually the wall under the manometer). Set up an organized approach (i.e. begin vacuuming one block and move slowly, in a row to assure that you cover the entire area). Draw vacuum hand-piece slowly towards yourself. Pay special attention to floor moldings. If molding is pulled away from the wall and you suspect that mercury may have gotten behind it, remove the molding using the putty knife and vacuum behind it.

7. Once the area under the manometer has been vacuumed, remove the manometer from the wall bracket by unscrewing the top holding screw. Place the manometer in the washbasin. If the glass tube is not broken on the front of the manometer and there is no visible mercury on the outside of the manometer, put the manometer inside the plastic bag. Seal the bag and place in washbasin. If the tube is broken, empty mercury into the washbasin to be vacuumed. Then put the manometer into plastic bag and seal.

8. Once all the mercury has been vacuumed, take the flashlight and check again for beads of mercury on the floor, wall and bed. Several attempts may be needed to vacuum all the mercury from the spill.

9. Place washbasin under mercury separator and unscrew jar. Place red cap over bottom of mercury separator and place red end cap on base. Any mercury that may have fallen on the paper should be dumped into the jar. Place lid and return jar to toolbox*.

   If water has been vacuumed, notify Environmental Health and Safety (EH&S) immediately so that the appropriate maintenance can be preformed.

10. Pick up all materials and leave room.

11. Leave manometer (in sealed bag) in the soiled utility room. The unit secretary should be informed to call to have the manometer replaced.

12. Post sign on the door to assure that the room remains browned out and no one enters until EH&S has checked the room.

13. Notify EH&S that the spill has been clean up. If the spill occurs during the normal 8-5:30 day, call EH&S immediately after clean up is complete. Please give the secretary the room number and other important details. If the spill occurs after 5:30 or on a weekend, leave a message on phone mail giving the room number and any other details about the spill.

14. EH&S will respond with the mercury vapor sniffer and a flashlight to assure adequate clean up. Mercury vapor levels should be insignificant (<0.02 mg/m3) at floor level.

15. The patient(s) may be returned to the room after EH&S has approved the room for use.

*Note: If mercury and spill debris reach the fill line on the jar, a Hazardous Waste Tag must be filled out. The tag should be completely filled out and attached to the jar. The Hazardous Waste Management Unit should be called to pick up the mercury.

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SAMPLE HOSPITAL ENVIRONMENTAL PROCEDURE

Title: *EMS-4.4.2 PROCEDURE FOR TRAINING, AWARENESS AND COMPETENCE*		
Document No: *EMS-4.4.2*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: *06/12/02*		
Next Revision Date: *06/03*		

1. Purpose

1.1 To ensure that environmental training needs are identified and appropriate training is provided.

Employee training is required for a number of regulations that have specific training requirements, as well as to improve knowledge of the Environmental Policy and environmental management system, general environmental performance and reduce environmental risk. The main topics of training include, but are not limited to:

- Environmental Policy,
- Environmental Management,
- Emergency Response,
- Waste Management,
- Transportation of Dangerous Goods,
- Chemical Management and Spill Response, and
- Environmental Awareness.

1.2 To ensure that employees with job functions that exhibit significant aspects are aware of:

- The importance of their roles and responsibilities in conforming with the Environmental Policy, job specific procedures and the requirements of the EMS; and
- The significant environmental impacts related to their work activities.

2. Scope

2.1 This procedure applies to all personnel whose work can have a significant impact on the environment and relates to all operations and programs conducted by [*insert hospital name*], located at [*insert hospital address*].

[I*nsert hospital name*] personnel also includes contracted personnel or contracted agencies.

3. Definitions

3.1 Definitions relating to the content of the EMS are contained in the Glossary.

4. Responsibility

4.1 It is the responsibility of the EMS Representative to reinforce and communicate commitment to the Environmental Policy (EMS- 4.2) and EMS related procedures.

4.2 It is the responsibility of all Department Managers/Supervisors to identify and hire personnel with the minimum education level, experience and skills for each job function in their areas, and to ensure training associated with operational controls is provided to these staff.

4.3 It is the responsibility of the EMS Representative to deliver needed environmental training, or

to obtain contracted service providers to deliver training.

5. Procedure

5.1 Job Qualifications

5.1.1 Human Resources, in collaboration with Department Managers/Supervisors, are responsible for determining the minimum education, experience, skill and competence levels that are needed to perform each job function in the hospital.

5.2 Training/Awareness for Department Specific Operational Controls

5.2.1 The EMS Representative and/or designate, in collaboration with Department Managers/Supervisors and Human Resources develops the "Operational Control and Training Requirements Chart" (EMS-4.4.6-1). The chart displays the environmental training/awareness activities identified for the employees that perform operations and activities with associated significant environmental aspects.

5.2.2 Attendance and other training related information is to be documented as per the hospital's existing Human Resources/Educational Services training documentation procedures.

5.2.3 Unless otherwise arranged, the Department Manager/Supervisor and/or designate conducts and/or arranges for his/her employees to receive the needed training/awareness and records the date of occurrence.

5.2.4 The EMS Representative and/or designate will periodically review the training records chart to ensure that needed training is being provided to department staff and that records are being kept up-to-date by Department Managers/Supervisors/ Educational Services.

5.3 Legislative and EMS Training

5.3.1 The EMS Representative and/or designate, in consultation with Department Managers/Supervisors and the Green Team, identifies the legislative and EMS training needs of hospital staff by completing a "Training Needs Analysis Worksheet" (Exhibit 1- EMS 4.4.2-2).

The EMS Representative and/or designate adds the identified legislative, EMS and other training needs to Exhibit and informs the Department Managers/Supervisors of the specific training requirements for their areas.

The EMS Representative and/or designate, will deliver or arrange for needed legislative and/or environment-related training.

5.3.2 Once the employee has completed his/her required training the EMS Representative and/or Educational Services will retain attendance sheets, tests, and other related information and forward a copy to associated Department Managers/Supervisors for their records.

5.4 New Employees

5.4.1 All new employees receive Environmental Awareness Training during the Orientation process.

5.4.2 Attendance sheets from the Orientation sessions are documented by Educational Services.

5.5 Contractor Training

5.5.1 All contractors/suppliers that the hospital has dealt with in the last year will be sent "EMS Information Packages" to inform them of their responsibilities in the hospital's EMS.

5.5.2 All departments that bring contractors on-site at the hospital will ensure that the contractors have received required EMS training.

6. References

CAN/CSA-ISO 14001 - 96 - Environmental Management System Standard
EMS- 4.2-Procedure for Environmental Policy
EMS- 4.4.6-1 Operational Control and Training Requirements Chart

7. Exhibits

Exhibit 1- EMS-4.4.2-1, Training Needs Analysis Worksheet

Title: **Training, Awareness and Competency**	**N/A**	**Date Revised:**
Number:	**VICE PRES/PRESIDENT**	**Revision No.: 0**
Effective Date:	**MGR./GEN.MGR**	**Page:**

Purpose

To establish a consistent approach to implementing the training that has been identified as being needed.

Scope

All employees' contractors and suppliers whose work at XXXX may create a significant impact upon the environment.

Definitions

None.

Reference Material

EMS Organizational Structure
Significant aspects
Environmental Policy
All Operational Control Procedures
Emergency Preparedness and Response Procedure
ISO 14001
Identification of Training Needs Procedure
Training Needs Matrix

V. **Procedure**/Policy

A. The Environmental Affairs or the control department will determine who needs which type of training, how long the training should last and the frequency of the training. The Environmental Affairs or the control department will also develop outlines for, descriptions of each type of training performed to promote consistency in the delivery and the content of the training.
B. Environmental Affairs or control department will coordinate all EMS related courses identified. Training related to the job specific operational controls will be conducted by production or related section supervisors. The primary method to train employees on the job specific operational controls is through training on the work instruction.
C. Personnel performing tasks which can cause significant environmental impacts shall be competent based on training, education, or experience.
D. Records of the training activities will be controlled as appropriate.

Retention Requirement

This document will be retained until revised.

Special Circumstances

None

Measurement of Performance

The performance of this portion of the EMS shall be measured through audits conducted by internal auditors, audit team and 3rd party auditor of which certification is acquired.

Appendix

N/A

Effective Date:		
Revision Number:		
Last Revision Date:		
ISO COORD	MGMT REP	ENV MGR

	Required For:							Supplemental Training For:								Initial Training By:							Refresher Freq:			
	All team members	All Team Members who operate/conduct	Group Leaders/Team Leaders/Assistant Man	Relevant Environmental T/M's	Section Appointed ISO Representatives	Contractors who operate/conduct	See notes	All team members	All Skilled Team Members	All Team Members who operate/conduct	Group Leaders/Team Leaders/Assistant Man	Relevant Environmental T/M's	Section Appointed ISO Representatives	Contractors who operate/conduct	See notes	Environmental in Assimilation	Contractor Safety Training	Training Center coordinator training	Lab Safety Training	Outside Contracted Trainer	Environmental Affairs	See Notes	Annually	Every 3 years	Not Required	See notes
ENVIRONMENTAL TRAINING																										
RCRA Hazardous Waste Mgt. Training				X																X			X			
ANNUAL RCRA TRAINING TO INCLUDE:																										
1. RCRA		X				X										X	X						X			
2. Emergency Response		X				X										X	X						X			
3. Solvent Management		X				X										X	X						X			
4. Spill Kit Training		X				X											X				X		X			
Lab Safety				X								X							X				X			
ISO 14001 General Awareness Training	X															X	X							X		
Significant Aspect Area Training		X																				X				
ISO Lead Auditor Training												X								X					X	
ISO Internal Auditor Training					X							X								X					X	
HAZWOPER		X		X		X														X			X			

Refresher Training By					
Environmental-Group Leaders	Environmental in Contractor Safety Training	G/L initial Training for all Team Members	Outside Contracted Trainer	See notes	NOTES:
			X		
X				X	
X					
X					
X					
X					
			X		

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Title: **External Communication Procedure**	**N/A**	**Date Revised:**
Number:	**VICE PRES/PRESIDENT**	**Revision No.: 0**
Effective Date:	**MGR./GEN.MGR**	**Page:**

I. Purpose

To define the method(s) that will be utilized to receive, document and respond to relevant communication from external interested parties.

II. Scope

All of the external communication that relates to environmental aspects.

III. Definitions

External Communication – That communication that occurs with interested parties in which there is a concern or a complaint from the external interested.

Reference Material

Emergency Preparedness & Response Procedure
Significant Aspects
Environmental Policy
Environmental Communications Request Form
Emergency Response List

IV. Procedure/Policy

A. The communication from an external interested party is received by the Company Receptionist or Corporate Communications or by a member of the Environmental Affairs Section.
B. Information received by the company receptionist or Corporate Communication is forwarded to Environmental Affairs.
C. The members of environmental affairs will verify the nature of the communication and either address it immediately (not requiring written documentation) or record the individuals/groups name and phone number and nature of the communication on the Environmental Communication (EC) and Environmental Affairs will either address the communication in a timely manner or consult with upper management if necessary.
D. The decision to communicate significant environmental aspects is done on a case by case basis by the manager of environmental affairs and upper management if necessary. An EC will be used to document the communication.

E. Once in the tracking system, the communication will be kept for consideration during updating significant aspects and objectives and targets.
F. The communication will be completed by Environmental Affairs or Corporate Communications depending upon the nature, size and scope of the situation.
G. A summary of the response or a copy of the response (if written) will be logged into the Environmental Communications (EC) tracking system.
H. In the event the emergency response system is activated, communication methodologies will be implemented consistent with those outlined in the Emergency Response Plan.

V. Retention Requirement

This document will be retained until revised.

a. Special Circumstances

N/A

b. Measurement of Performance

The performance of this portion of the EMS shall be measured through audits conducted by internal auditors, audit team and 3rd party auditor of which certification is acquired.

Appendix

N/A

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Title: **Internal Communication Procedure**	**N/A**	**Date Revised:**
Number:	**VICE PRES/PRESIDENT**	**Revision No.: 0**
Effective Date:	**MGR./GEN.MGR**	**Page:**

1. Purpose

To establish the methods that will be utilized to communicate internally on environmental aspects and the Environmental Management System.

Scope

The scope includes all of the internal communication that relates to environmental aspects.

I. Definitions

Internal Communication – That communication that occurs between employees, or contractors/suppliers who work on behalf of [insert hospital name] within the confines of the site.

Reference Material

All EMS Procedures
All EMS Records
Environmental Policy

II. Procedure/Policy

B. XXXX Environmental Affairs communicates to facility personnel relevant information regarding the environmental management system in the following manner:

1) Policy – Distribute Policy Cards and send fliers to all employees
2) Significant Aspects – The list is discussed with section managers.
3) Legal and Other requirements – Distribute a list of general regulations through General Awareness Training. Distribute specific legal requirements to relevant engineering sections.
4) Objectives and Targets – The objectives are discussed with section managers.
5) EMP – The EMP's are given approval or disapproved with reason why disapproved.
6) Structure and Responsibility – Roles and responsibility are distributed.
7) Training Awareness Competency – All training is considered communication.
8) Communication – The methods to communicate to Environmental Affairs through general awareness training.

9) EMS Documentation – Copies of the manual will be communicated via the web site.
10) Document Control – General document control requirement are communicated to section managers via review meeting and section ISO Representatives via Internal Auditor Training Class.
11) Operational Control - General document control procedures are reviewed and recommendations are communicated to relevant sections via the Environmental Key Point proposal.
12) Emergency Preparedness and Response – The Emergency response are communicated during the annual RCRA training.
13) Monitoring and Measuring – The requirements for generating documented monitoring/measuring Procedures and to perform calibration on monitoring/measuring equipment is communication to section ISO representatives via "objectives and targets". Performance tracking for objectives and targets are communicated back to the responsible sections.
14) Nonconformance Corrective and Preventive Action – Nonconformance reports will be reviewed and response will be communicated back to the report initiator.
15) Records – General record keeping requirement will be communicated to section managers.
16) EMS audits – Results of EMS audits are communicated to upper management and relevant section managers. Training requirements for internal auditors and training schedules are communicated to relevant ISO section representatives.
17) Management Review – The necessary information to carry out the review will be communicated to upper management.

C. Facility personnel communicate to Environmental Affairs and other relevant sections regarding the environmental management systems in the following manner:
1) Significant Aspects – New developments that might impact the environmental Impact Assessment Form.
2) Objectives and Targets – Relevant sections will communicate status.
3) EMP – Relevant sections will communicate status.
4) Structure and Responsibility – Changes in the organizational structure will be communicated from HR.
5) Training Awareness and Competency – Training personnel and reporting results back to E/A.
6) Document Control – More specific (section) document control requirements are communicated to those employees who have responsibility to generate or modify documents.
7) Operational Control – Status of controlling the relevant operations (activities).
8) Emergency Preparedness and Response – Report emergencies.

9) Monitoring and Measuring – Inform E/A of the current monitoring/measuring and calibrations being done or needing to be done. Report appropriate monitoring and measuring results to E/A.
10) Nonconformance Corrective and Preventive Action – Report non-conformances and communicate new procedures or requirements that are a result of corrective and preventive action.
11) Records – Submit Environmental related records to E/A.
12) EMS audits – Communicate results within own section and to Environmental Affairs to promote awareness and to prevent future occurrences.
13) Management Review – Communicate results to relevant personnel within own sections.

a. Retention Requirement

This document will be retained until revised.

b. Special Circumstances

None.

c. Measurement of Performance

The performance of this portion of the EMS shall be measured through audits conducted by internal auditors, audit team and 3rd party auditor of which certification is acquired.

Appendix

N/A

ENVIRONMENTAL COMMUNICATION FORM

Tracking #_____

Date:_____ Extension:_____
Originated by: _____ Mail Code:_____
Cost Center: _____

Step 1. **Communication Details:** _____

_____

_____

_____

_____

_____

(Environmental Affairs Only)

Step 2.

☐ **Recommendation** ☐ ☐ ☐ ☐ _____

☐ ☐ ☐ ☐

☐

Specialist Assigned: _____ ☐ _____

Responded on: _____

Response to Dept.: _____

_____

_____

_____

Dept. Response (Long Term C/M required**)**

Step 3.

Short Term C/M (Corrective Action)

Dept. Mgr	**Env Mgr**

Long Term C/M (Preventive Action)

☐ **C/M Completed**

☐ **C/M to be Completed** **Completion Date:** _____ (*Return to XXXX*)

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SAMPLE HOSPITAL ENVIRONMENTAL PROCEDURE

Title: *EMS-4.4.5 PROCEDURE FOR DOCUMENT CONTROL*		
Document No: *EMS-4.4.5*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: *08/12/02*		
Next Revision Date: *08/03*		

1. Purpose

1.1 To ensure that all EMS documentation required by the ISO 14001 Standard is established and maintained so that they can be located, periodically reviewed, and kept up-to-date.

1.2 To ensure documentation is available at all locations where operations essential to the effective functioning of the environmental management system are performed.

2. Scope

2.1 This policy governs the EMS documentation related to the operations and programs conducted by [hospital name], located at [*insert hospital address*].

3. Responsibility

3.1 It is the responsibility of the EMS Representative and/or designate to maintain the EMS documentation in a manner consistent with the ISO 14001 requirements.

4. Procedure

4.1 An electronic version of the EMS Policy and Procedure Manual is available to all hospital staff on the hospitals computer system.

4.2 The EMS Representative and/or designate is the only individual with open access to the electronic EMS Policy and Procedure Manual. The EMS Representative and/or designate is responsible for maintaining the electronic version of the manual.

4.3 A paper copy of the EMS Policy and Procedure Manual is retained and available for use in the EMS Representative's office.

4.3.1 Both the paper copy and electronic copy of the EMS Policy and Procedure Manual are "Master" copies and are maintained by the EMS Representative and/or designate.

4.3.2 If a new document supercedes an existing document, the existing document is removed and recycled by the EMS Representative and/or designate.

4.3.3 The EMS Representative and/or designate must ensure that "Obsolete" documents are replaced with dated "Master" copies.

4.3.4 Documents retained for legal and/or knowledge preservation are identified in the "Master Document Control List" (Exhibit 1-EMS-4.4.5-1).

4.4 Versions or specific components of the manual are available to community members and/or staff as "Educational/Informational Tools" only.

4.5 If at any time, an employee wishes to comment on an EMS procedure, he/she must contact the EMS Representative to request needed changes.

4.6 If at any time an employee would like to report a nonconformance, he/she must fill out an "Employee Incidence Report" (EMS-4.5.2), and/or inform the EMS Representative of the occurrence.

4.7 The following is documented on the "Master Document Control List":

- identification, location, current revision number, revision schedule and the retention time of key EMS documents required to ensure compliance with the ISO 14001 Standard, and
- applicable environmental legislation, and/or potential liabilities

5. Definitions

5.1 Definitions relating to the content of the EMS are contained in the Glossary.

6. References

ISO 14001-96- Environmental Management System Standard
EPPM-4.4.3- Procedure for Communication
EPPM-4.4.4- Procedure for Environmental Management System Documentation
EPPM-4.5.2- Procedure for Nonconformance and Corrective and Preventive Action.

7. Exhibits

Exhibit 1- EMS-4.4.5-1- Master Document Control List

Hospital Environmental Procedure

Procedure Number: **Effective Date:**
Title: Document Control

1. **PURPOSE:**

   This procedure describes the process for creating, issuing and controlling Environmental Management System (EMS) documents, both electronic and hard copy.

2. **ACTIVITIES AFFECTED:**

   All hospital environmental activities.

3. **FORMS USED:**

   None.

4. **REFERENCES:**

   4.1 Creating, Issuing, Numbering, and Controlling EMS Documents
   4.2 Document and Data Control
   4.3 Records Management
   4.4 Internal Environmental Communications
   4.5 Training
   4.6 Spill Prevention Control and Countermeasures (SPCC) Plan
   4.7 Computer System Disaster Recovery
   4.8 Master List of Environmental Records

5. **DEFINITIONS:**

   5.1 Document – a set of instructions, in any form, pursuant to implementing and maintaining the established environmental management system. A document may be initiated, revised, or deleted at any time as the situation warrants. Examples of a document include (but are not limited to):
   - 5.1.1 Procedure
   - 5.1.2 Work Practice
   - 5.1.3 Policies
   - 5.1.4 Forms
   - 5.1.5 SPCC Plan

   5.2 Controlled document – a document subject to the creation, review, modification, approval and distribution requirements described in this

procedure for local documents, or to the method employed by the activity supplying the document. Normally, a controlled document is used to provide instruction. The status of a document as controlled is specified on and verified through the master Document List located on the Intranet.

5.3 Master Document List – a list identifying all controlled documents relating to the EMS. The list contains the following items for each document:

5.3.1 The document title.
5.3.2 If the document is stored in a computer system, the file name for the document.
5.3.3 The location of the master copy.
5.3.4 The latest authorized version date.
5.3.5 The user location(s).

6. **EXCLUSIONS:**

None.

7. **PROCEDURE:**

7.1 HARDCOPY CONTROLLED DOCUMENTS (SPCC PLAN ONLY):

7.1.1 The Master will be kept with the Environmental Control Specialist.
7.1.2 Controlled copies of the Master will be numbered sequentially and identified as such on the Master Document List.
7.1.3 Changes may be requested by activity to the Environmental Control Specialist. The Environmental Control Specialist, or his designee, will make any required changes to the Master and will update all controlled copies.

7.2 ELECTRONICALLY CONTROLLED DOCUMENTS (ALL EMS DOCUMENTS EXPECT SPCC PLAN):

7.2.1 The need for a new or revised document will be communicated to the Environmental Control Specialist.
7.2.2 The Environmental Control Specialist, or designated CFT member, solicits comments from affected individuals or activities and drafts the document for CFT review in accordance with Document Control Procedure.
7.2.3 Upon CFT review and approval, the Environmental Control Specialist or his designee authorizes the procedure and updates the Master Document list.
7.2.4 The Environmental Control Specialist or his designee distributes the notification of a new or revised document to all Salaried

Employees via email. Supervisors, or their designees, of hourly employees are responsible for communicating any changes affecting their employees to them via Training Procedure and Internal Communication Procedure.

7.2.5 The latest revision date for current documents will be tabulated on the Master Record's List.

8. **GENERAL RULES:**

8.1 The following must be included on any document on every page:

8.1.1 A title and/or number uniquely identified.
8.1.2 The effective, or latest revision date.
8.1.3 Identity of originating (authorizing) activity.
8.1.4 Page numbering (x of total).

8.2 For any document contained within a computer system, that computer system must be safeguarded to prevent unauthorized use or revision, for example by use of password protection, or encryption. This requirement includes master copies as well as controlled copies of documents so contained.

8.3 A controlled disk copy will be maintained by the Environmental Control Specialist in the hospital vault.

9. **ENVIRONMENTAL RECORDS:**

Data and records generated by use of this procedure shall be maintained in accordance with all Corporate, Division and Plant Records Management guidelines.

10. **RECORD OF REVISIONS:**

Date:	Description:	Pages affected:	Authorized by:
	Reformatted	All	
	Rewrote the procedure to be specific to a document system controlled on a computer system	All	
	Entire procedure rewritten to reflect both electronic and hard copy control.	All	
	Changes made to reflect division staff	All	
	Change Corporate to Global, and add 7.2.5	All	
	Text change	All	

Title: *EXHIBIT 1- EMS-4.4.5-1 MASTER DOCUMENT CONTROL LIST*		
Document No: *EMS-4.4.5-1*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: *08/12/02*		
Next Revision Date: *08/03*		

DOCUMENT	DOCUMENT NO.	LOCATION(S)	RETENTION TIME	REVIEW FREQUENCY
Manual Distribution List	Distribution List	1. EMS P&P Manual(s) ***(EMS Rep's Office, Electronic)***	Retain 2 years	Annually
Glossary	Glossary	1. EMS P&P Manual(s)	Retain 2 years	Annually
Environmental Policy	EMS-4.2-1	1. EMS P&P Manual(s) 2. EMS Records Binder 3. Main Lobby 4. Cafeteria 5. Administration Building 6. Main Elevator Landing	Retain 2 years	Annually
Procedure for Environmental Policy	EMS- 4.2	1. EMS P&P Manual(s)	Retain 2 years	Annually
Procedure for Environmental Aspects	EMS- 4.3.1	1. EMS P&P Manual(s)	Retain 2 years	Annually
Significance Evaluation Criteria for Environmental Impacts	EMS-4.3.1-1	1. EMS P&P Manual(s) 2. Environmental Records Binder (in EMS Rep's Office)	Retain 2 years	Annually
Environmental Aspects & Impacts Chart	EMS-4.3.1-2	1. EMS P&P Manual(s) 2. Environmental Records Binder	Retain 2 years	Annually
Procedure for Legal and Other Requirements	EMS 4.3.2	1. EMS P&P Manual(s)	Retain 2 years	Annually
Legislative, Regulatory and Other Requirements for Health Care	EMS-4.3.2-1	1. EMS P&P Manual(s) 2. Environmental Records Binder	Retain 2 years	Annually
Environmental Legislation & Regulations	N/A	1.Environmental Law Guide 2. Federal/Provincial Websites 3. Respective Department(s)	Retain until updated copy are available	As Needed
Procedure for Objectives and Targets	EMS 4.3.3	1. EMS P&P Manual(s)	Retain 2 years	Annually
Objectives & Targets Chart	EMS- 4.3.3-1	1. EMS P&P Manual(s) 2. Environmental Records Binder	Retain 5 years	Semi-Annually
Procedure for Environmental Management Program(s)	EMS 4.3.4	1. EMS P&P Manual(s)	Retain 2 years	Annually
Environmental Management Program(s)	EMS 4.3.4-1	1. EMS P&P Manual(s) 2. Environmental Records Binder	Retain 2 years	Semi-Annually

Procedure for Structure and Responsibility	EMS- 4.4.1	1. EMS P&P Manual(s)	Retain 2 years	Annually
Hospital Organizational Chart	Jan-2002	1. EMS P&P Manual(s) 2. Electronic Version	Retain	Annually
EMS Roles & Responsibilities Chart	EMS-4.4.1-2	1. EMS P&P Manual(s)	Retain 2 years	Annually
Procedure for Training, Awareness, & Competence	EMS- 4.4.2	1. EMS P&P Manual(s)	Retain 2 years	Annually
Employee EMS Training & Awareness Records Chart	EMS-4.4.2-1	1. Electronic Version	Retain	At Least Annually
Training Needs Analysis Worksheet	EMS- 4.4.2-2	1. EMS P&P Manual(s) 2. Environmental Records Binder	Retain 2 years	Annually
Training Records	N/A	1. Educational Services 2. Human Resources	Retain	Annually
Procedure for Communication	EMS- 4.4.3	1. EMS P&P Manual(s)	Retain 2 years	Annually
Procedure for Environmental Management System Documentation	EMS- 4.4.4	1. EMS P&P Manual(s)	Retain 2 years	Annually
Procedure for Document Control	EMS- 4.4.5	1. EMS P&P Manual(s)	Retain 2 years	Annually
Master Document Control List	EMS-4.4.5-1	1. EMS P&P Manual(s) 2. EMS Records Binder	Retain 2 years	Annually
Procedure for Operational Control	EMS- 4.4.6	1. EMS P&P Manual(s)	Retain 2 years	Annually
Operational Control & Training Requirements Chart	EMS-4.4.6-1	1. EMS P&P Manual(s) 2. Environmental Records Binder	Retain 2 years	Annually
Operational Procedures for Significant Environmental Aspects)	N/A- Department Specific	1. Departmental Procedures in hospital computer system 2. Located in Designated Departments	Retain 2 years	Annually
Procedure for Emergency Preparedness and Response	EMS–4.4.7	1. EMS P&P Manual(s)	Retain 2 years	Annually
Hospital Emergency Procedures & Codes	Code Brown Code Red Code Green Code Orange Code Black	1. Electronic Version(s) 2. Contingency Binders in each Department	Retain 2 years	Every 3 years

	Code White Code Yellow Code Blue			
Procedure for Monitoring and Measurement	EMS-4.5.1	1. EMS P&P Manual(s)	Retain 2 years	Annually
Monitoring & Measurement Documentation Chart	EMS-4.5.1-1	1. EMS P&P Manual(s)	Retain 2 years	Annually
EMS Audits	N/A	1. Environmental Audits Binder (EMS Rep's Office)	Retain	As Needed
Other Environmental Audits/Reports	N/A	1. Associated Departments 2. Environmental Audits Binder	Retain	As Needed
Preventive Maintenance Records	N/A	1. Engineering Services 2. Associated Departments	Retain 2 years	As Needed
Procedure for Non-Conformance, Corrective and Preventive Action	EMS- 4.5.2	1. EMS P&P Manual(s)	Retain 2 years	Annually
Employee Incident Report	N/A	1. Occupational Health Center 2. Distributed throughout Departments	Retain	As Needed
Procedure for Records	EMS- 4.5.3	1. EMS P&P Manual(s)	Retain 2 years	Annually
Procedure for Environmental Management System Audit	EMS- 4.5.4	1. EMS P&P Manual(s)	Retain 2 years	Annually
EMS Audit Checklist	EMS-001	1. EMS P&P Manual(s)- Appendix 2. Environmental Audits Binder	N/A	As Needed
Procedure for Management Review	EMS- 4.6.1	1. EMS P&P Manual(s)	Retain 2 years	Bi-Annually
Training Records	N/A	1. Training Records Binder (EMS Rep's Office) 2. Department Managers/ Supervisors Office 3. Manager, Educational Services Office	Retain	As Needed
Audits (EMS, Waste, Compliance, etc.)	N/A	1. Environmental Audits Binder (EMS Rep's Office)		
Waste Manifests	N/A	1. Housekeeping Office	Retain	N/A
Certificate of Approval (Air)	N/A	1. Engineering Services	Retain	N/A
Radioisotope License	N/A	1. Nuclear Medicine	Retain	Annually
Green Team-Terms of Reference	N/A	1. Electronic Hospital Policy and Procedure Manual	Retain 1 year	Annually

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SAMPLE HOSPITAL ENVIRONMENTAL PROCEDURE

Title: *EMS-4.5.3 PROCEDURE RECORDS*		
Document No: *EMS-4.5.3*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: 1*5/06/02*		
Next Revision Date: *06/03*		

1. Purpose

1.1 To ensure that environmental records are established, maintained and disposed of, in accordance with the standard.

2. Scope

2.1 This policy governs the operations and programs conducted by [hospital name], located at [*insert hospital address*].

3. Responsibility

3.1 The EMS Representative is responsible for ensuring that environmental records are readily retrievable and protected against damage and maintained in a manner consistent with the requirements of ISO 14001.

4. Procedure

4.1The EMS Representative and/or designate records the applicable environmental records requiring control, proper storage, and retention in the "Document Control Chart" (EMS- 4.4.5-1). Environmental records can include, but are not limited to the following:

- training records,
- regulatory inspection reports,
- internal/external communication logs,
- legislative and regulatory requirements,
- inspection, calibration and maintenance activity,
- performance indicator data,
- environmental audits and management reviews,
- incident reports.

4.2 Records are located in the Environmental Performance Indicators Binder, Training Records Binder, The Environmental Legislation and Regulations Binder, The Environmental Audits Binder and the EMS Records Binder located in the EMS Representative's office.

4.3 The EMS Representative is responsible for ensuring that records are stored and maintained in a manner to ensure that they are readily retrievable and protected against damage.

4.4 The EMS Representative is responsible for ensuring that obsolete documents are

destroyed.

5. Definitions

5.1 Definitions relating to the content of the EMS are contained in the Glossary.

6. References

ISO 14001 - 96 - Environmental Management System Standard
EMS- 4.4.5 - Procedure for Document Control
EMS- 4.4.5-1- Document Control Chart

7. Exhibits

N/A

[HospitalName]	EMS Procedure	**4.4**
	Effective Date	
	Subject	**Records**

Purpose This procedure is used to maintain EMS records.

Step 1 The EMS Manager and other personnel selected by the EMS Manager are Responsible for identifying records that are maintained by the company as part of the EMS.

Step 2 The EMS Manager and other personnel will maintain all records in a single location.

Step 3 The EMS Manager and other personnel will maintain a document index of all records that are maintained as part of the EMS, the data and person responsible for the length of retention for each type of record.

Step 4 The EMS Manager and other facility personnel will identify and note on the document index any restrictions on records necessary for security.

Step 5 The EMS Manager and other facility personnel will review the records and purge obsolete Records at least every (insert time frequency appropriate for your hospital and circumstances).

Types of Records You Might Maintain (Examples):

- Legal, regulatory, and other code requirements
- Results of environmental aspects identification
- Reports of progress toward meeting objectives and targets
- Permits, licenses, and other approvals
- Job descriptions and performance evaluations
- Training records
- EMS audit and regulatory compliance audit reports
- Reports of identified nonconformities, corrective action plans, and corrective action tracking data
- Hazardous material spill/other incident reports
- Communications with customers, suppliers, contractors, and other external parties
- Results of management reviews
- Sampling and monitoring data
- Maintenance records
- Equipment calibration records

Responsible Person: _____

Signature and Date: _____

MASTER INDEX OF ENVIRONMENTAL RECORDS

All records are to be stored and retained in accordance with the information stated below. Refer to the Corporate Records Manual (CRM) for any further guidance. To access the CRM electronically, type "CRM" at the command line from the main menu on your computer desktop.

Issue Date:

All Records Stored in the Environmental Section unless otherwise noted

TYPE OF RECORD	STORAGE LOC.	RET. TIME
MEETINGS:		
• Operating Review Quarterly	File Cabinet	3
• Cross Functional Team	EHS Desk	3
• Management Review	EHS Desk	3
• Incident Management	Security Office	3
• Waste Minimization	EHS Bookshelf	3
• Annual Energy	Division Office	3
INSPECTIONS		
• Self Assessments	File Cabinet	3
• Hazardous Waste Weekly (Satellites)	EHS Bookshelf	3
• Monthly Property (Pollution)	Bookshelf	3
• Agency Visits (Air)	File Cabinet, Bookshelf	3
• Agency Visits (Water)	File Cabinet, Bookshelf	3
• Hazardous Waste Storage Area	File Cabinet	3
• Outside Aesthetics	Bookshelf	3
AUDIT REPORTS		
• Compliance Assurance Findings/Checklist	File Cabinet	3
• Agency Report	Bookshelf, File Cabinet	3
• Internal Audit Reports	EHS Bookshelf	10
❖ Audit Schedule	EHS Bookshelf	10
❖ Activity Forms	EHS Bookshelf	10
❖ CAR's	EHS Bookshelf	10
• Audit Results	EHS Bookshelf	10

AIR RELATED

• Air Reg's applicable to Hospital	Bookcase	Until Revised
• Certificate of Operations	Bookcase	Until Revised
• Annual Emission Statement	Computer/bookshelf	3
• Fees Paid	Bookshelf	3
• Boiler Opacity	Bookshelf/Powerhouse	3
• Inspector Safety Checklist	Bookshelf	3
• P.M. on Mist Collectors	Housekeeping	3
• Community Right To Know (SARA)	File cabinet/Bookshelf	3
• CFC's		
❖ Stationary Service Records	Building Maintenance	3
❖ CFC Certifications For Mechanics	Bookshelf	Until revised
❖ Equipment Inventory	Building Maintenance	Life of equipmt.
• Title V Permit Application	Book cabinet	Until revised
• FESOP Permit	Bookshelf	Until revised
• Boiler		
❖ Annual Insurance Inspection	Boiler room	3
❖ Routine Maintenance Plant	Boiler room	3
❖ Daily Operator Logs	Boiler room	3

WATER RELATED

• Pretreatment Permit To Discharge Wastewater	Bookshelf/Waste Plant	Until revised
• Monthly Discharge Reports	Bookshelf	3
• Stormwater Permit & Summary	Bookshelf	Until revised
• Stormwater Analyses	Bookshelf	3
• Report of Contact	File Cabinet/Bookshelf	3

WASTE RELATED

• Manifests		
❖ Hazardous Wastes	EHS Desk	5
❖ Land ban	EHS Desk	5
• Waste Characterizations & Analytical	EHS Desk	Until revised
• List of Industrial Waste	EHS Desk	3
• Special Waste Permits	EHS Desk	Until expired
• Medical Waste Manifest	Hospital	5
• Waste Minimization Metrics	Bookshelf, Computer	3
•		

PCB RELATED

• Report of Contact	Book cabinet	Life + 3
• Notification of PCB Activity	Book cabinet	Life + 3
• Annual OCB Logs	Book cabinet	Life + 3
• Manifests	Book cabinet	Life + 3
• Certificates of Disposal	Book cabinet	Life + 3
• Spill Logs	Book cabinet	Life + 3

STORAGE TANKS

• USTS		
▪ Listings, Designations, Locations	Bookshelf	Life + 5
▪ Annual Fees		Life + 5
▪ Release Notifications		Life + 5
▪ Financial Assurance		Life + 5
▪ Closure Reports		Ownership+ 3
▪ Closure Approvals		Life + 5
• Above Ground Storage Tanks		
▪ Listings, Designations, Locations	Bookshelf	Life + 5

EMERGENCY PLANNING

• SARA Reports	Bookshelf	3
• Incident Management Plan	Bookshelf/Security	Until revised
• Spill/Emergency Plan	Bookshelf/Security	Until revised
• Mock Incident Logs	Security	3
• Community Compliant/Inquiry Concerns	Bookshelf	3

FUEL & UTILITIES

• Electric Bills	Powerhouse	3
• Monthly Utilities (Summary)	Powerhouse	3
• Gas Contracts	Powerhouse	3
• Gas Meter Readings	Powerhouse	3
• Gas Nominations	Powerhouse	3
• Water Bills	Powerhouse	3

• Sewer Bills	Powerhouse	3
• Self Reporting Data for Sewer Bills	Powerhouse	3
• Coal Reports to US Department of Energy	Powerhouse	3

TRAINING

• Training Matrix	Bookshelf	3
• Training Content (RCRA)	Bookshelf	3
• Training Attendance (RCRA)	Bookshelf	3
• All Environmental Training Record	Training Dept.	Employment+3

GENERAL

• Vendor Information	File Cabinet	Until revised
• Master Agreement Suppliers	Bookshelf	Until revised
• Requests for Toxicology Approval	Intranet	3
• Inspection Issue/Action Plan	File Cabinet	3
• Annual Compliance Assurance Letter	File Cabinet	3
• Environmental Checklist-New machines	Book Cabinet	3
• Radioactive Equipment Registrations	File Cabinet	Life + 3
• Available Equipment Registration	Avail. Equip. Section	3
• Ergonomic Files	Safety	3
• Plant Loss Control Inspections	Supervisors	1
• ISO 14001 EMS	Computer & Intranet	3
• ISO 14001 Forms	Computer & Intranet	3
• Community Complaints/inquiry Log	Bookshelf	3

PLANT DIAGRAMS

• Natural Gas Distribution	Intergraph System	Until Revised
• Water Distribution	Intergraph System	Until Revised
• Underground Drainage System	Intergraph System	Until Revised
• Roof Plan of Exhaust & HVAC	Intergraph System	Until Revised
• Department Diagram	Intergraph System	Until Revised
• Coolant System	Intergraph System	Until Revised
• Industrial Washers	Intergraph System	Until Revised
• Underground Electric Utilities	Intergraph System	Until Revised
• Fire Loop	Intergraph System	Until Revised
• Stormwater Distribution	Intergraph System	Until Revised
• Site Plan	Intergraph System	Until Revised
• Steam Lines / Condensate Lines	Intergraph System	Until Revised
• Cooling Tower Water Lines	Intergraph System	Until Revised

NOTE: All retention time numbers represent years and all records involved in litigation must be kept indefinitely. Files are located in Chem and Met Lab Supervisors office unless noted.

SAMPLE HOSPITAL ENVIRONMENTAL PROCEDURE

Title: *EMS-4.6 PROCEDURE FOR MANAGEMENT REVIEW*		
Document No: *EMS-4.6*	**Prepared By:** *EMS Representative*	**Approved By:** *EMS Management Representative*
Date Approved: *06/20/02*		
Next Revision Date: *06/03*		

1. Purpose

1.1 To establish a procedure to ensure that the hospital's Environmental Management System is periodically reviewed and revised, when needed, by hospital management to ensure its continued suitability, adequacy and effectiveness.

2. Scope

2.1 This procedure applies to all aspects of the EMS associated with the operations and programs conducted by [*insert hospital name*], located at [*insert hospital address*].

3. Definitions

3.1 Definitions relating to the content of the EMS are contained in the Glossary.

4. Responsibility

4.1 It is the responsibility of the EMS Representative and/or designate to ensure that the EMS is audited on a regular basis and that environmental performance data is included in the hospital's Annual Environmental Report.

4.2 It is the responsibility of the hospital's senior management team to review, provide feedback, and when needed, approve EMS documentation and audit findings, on a regular basis.

5. Procedure

5.1 The EMS Representative and/or designate reports on the progress of the EMS, environmental programs, and other related initiatives to the senior management team or representative through the hospital's monthly reporting structure.

5.2 The EMS Representative and/or designate summarizes and presents compliance and EMS audit findings to the hospital's senior management or representative and the Green Team on a regular basis.

5.3 The EMS Representative and/or designate utilizes the Annual Environmental Report to report on the progress of environmental objectives and targets (EMS-4.3.3), environmental performance indicators, and appropriateness of the hospital's Environmental Policy (EMS-4.2).

5.4 The senior management team provides the initial review and approval of the Annual Environmental Report. The resulting changes are then incorporated into the report by the EMS Representative before the report is passed on to other hospital committees and groups.

5.5 Feedback from the Senior Management Team and other interested parties is incorporated into the process of setting and reviewing environmental objectives and targets (EMS-4.3.3) by the hospital's Green Team.

6. References

ISO 14001 - 96 - Environmental Management System Standard
EMS-4.2 – Procedure for Environmental Policy
EMS- 4.3.3-Procedure for Environmental Objectives and Targets

7. Exhibits

N/A

EMS Procedure: Environmental Management System Audits

I. Purpose

To define the process for conducting periodic audits of the environmental management system (EME). The procedure defines the process for scheduling, conducting, and reporting of EMS audits.

II. Scope

This procedure applies to all internal EMS audits conducted at [hospital name].

The scope of EMS audits may cover all activities and processes comprising the EMS or selected elements thereof.

III. General

Internal EMS audits help to ensure the proper implementation and maintenance of the EMS by verifying that activities conform with documented procedures and that corrective action are undertaken and are effective.

All audits are conducted by trained auditors. Auditor training is defines by Procedure #. Records of auditor training are maintained in accordance with Procedure #.

When a candidate for EMS auditor is assigned to an audit team, the Lead Auditor will prepare an evaluation of the candidate auditor's performance following the audit.

The ISO Management Representative is responsible for maintaining EMS audit records, including a list of trained auditors, auditor training records, audit schedules and protocols, and audit reports.

EMS audits are scheduled to ensure that all EMS elements and plant functions are audited at least once each year.

The ISO Management Representative is responsible for notifying EMS auditors of any upcoming audits a reasonable time prior to the scheduled audit date. Plant areas and functions subject to the EMS audit will also be notified a reasonable time prior to the audit.

The Lead Auditor is responsible for ensuring that the audit, audit report and any feedback to the plant areas or functions covered by the audit is completed per the audit schedule.

The ISO Management Representative, in conjunction with the Lead Audit, is responsible for ensuring that Corrective Action Notices are prepared for audit finings, as appropriate.

IV. Procedure

A. Audit Team Selection – One or more auditors comprise an audit team. When the team consists of more than one auditor, a Lead Auditor will be designated. The Lead Auditor is responsible for audit team orientation, coordinating the audit process, and coordinating the preparation of the audit report.

B. Audit Team Orientation – The Lead Auditor will assure that the team is adequately prepared to initiate the audit. Pertinent policies, procedures, standards, regulatory requirements and prior audit reports are made available for review by the audit team. Each auditor will have appropriate audit training, as defined by Procedure #.

C. Written Audit Plan – The Lead Auditor is responsible for ensuring the preparation of a written plan for the audit. The Internal EMS Audit Checklist may be used as a guide for this plan.

D. Prior Notification – The plant areas and / or functions to be audited are to be notified a reasonable time prior to the audit.

E. Conducting the Audit

1. A pre-audit conference is held with appropriate personnel to review the scope, plan and schedule for the audit.
2. Auditors are at liberty to modify the audit scope and plan if conditions warrant.
3. Objective evidence is examined to verify conformance to EMS requirements, including operating procedure. All audit findings must be documented.
4. Specific attention is given to corrective actions for audit findings from previous audits.
5. A post-audit conference is held to present audit findings, clarify any misunderstandings, and summarize the audit results.

F. Reporting Audit Results

1. The Team Leader prepares the audit report, which summarizes the audit scope, identifies the audit team, describes sources of evidence used, and summarizes the audit results.
2. Findings requiring corrective action are entered into the corrective action database.

G. Audit Report Distribution

1. The ISO Management Representative is responsible for communicating the audit results to responsible area and / or functional management. Copies of the audit report are made available by the ISO Management Representative.

2. The ISO Management Representative is responsible for ensuring availability of audit reports for purpose of the annual Management review (see Procedure #).

H. Audit Follow-up

1. Management in the affected areas and / or functions are responsible for any follow-up actions needed as a result of the audit.
2. The ISO Management Representative is responsible for tracking the completion and effectiveness of corrective actions.

I. Record Keeping

1. Audit reports are retained for at least two years from the date of audit completion. The ISO Management Representative is responsible for maintaining such records.

Hospital Environmental Procedure

Procedure Number: **Effective Date:**
Title: Management Review of Environmental Systems

1. **PURPOSE:**

   This procedure establishes the [hospital] method of performing management review of the environmental management system.

2. **ACTIVITIES AFFECTED:**

   All environmental management system components.

3. **FORMS USED:**

   None.

4. **REFERENCES:**

   4.1 EMS Master Document List
   4.2 Management Review Procedure

5. **DEFINITIONS:**

   OCM: Operating committee for this process shall include but not necessarily be limited to Facility Manager, Quality Manager, Engineering Manager, Area Managers, Employee Relations Manager, Controller, or designees.

6. **EXCLUSIONS:**

   None.

7. **PROCEDURE:**

   7.1 The Environmental Management Representative will schedule a meeting for the CFT to present the Environmental Management System (EMS) for OCM review at least once each year.

   7.2 The CFT will review the following items as appropriate prior to the OCM management review meeting:

      7.2.1 All documents included in the document control procedure.
      7.2.2 Regulatory and other requirement which shall include:
         7.2.2.1 Any breach of permits
         7.2.2.2 Status of agency approvals

7.2.2.3 Notification of unauthorized releases
7.2.2.4 Compliance with hospital and environmental plan
7.2.2.5 Major incidents
7.2.2.6 Corrective and preventive action status

7.2.3 Progress against objectives, targets and programs.
7.2.4 Complaints and internal and external communications.
7.2.5 Environmental aspects and any trends in significant aspects that alter the environmental performance at the plant.
7.2.6 Environmental training and awareness initiatives.
7.2.7 Area and site wide summaries of aspects.
7.2.8 Auditing schedule and findings.
7.2.9 Structure and responsibility.
7.2.10 Emergency preparedness and response.
7.2.11 Evaluation and trends of the plant waste matrix such as reductions or increases in wastes.

7.3 The Cross Functional Team (CFT) shall develop a review presentation of the EMS for the OCM based upon the above review.

7.4 The OCM shall evaluate the policy, objectives and other elements of the EMS for continued suitability, adequacy and effectiveness. If changes are required the OCM shall issue directives to the CFT to identify and implement corrective and preventive actions as well as assign responsibilities for implementing of those actions.

7.5 The Environmental Control Specialist shall be responsible for recording meeting minutes, identifying issues discussed, corrective and preventive actions and responsibilities.

8. **GENERAL RULES:**

None.

9. **ENVIRONMENTAL RECORDS:**

Meeting agendas, attendance records and records of the minutes from the management review shall be kept in accordance to Corporate Records Management (CRM) Retention Schedule and kept with CFT meeting minutes.

10. **RECORD OF REVISIONS:**

Date:	Description:	Pages affected:	Authorized by:
	Reformatted	All	
	Add Environmental Management Representative to 7.1	All	
	Change case in 7.2	All	
	Modify 7.2.6, add 7.2.11	All	

[HospitalName]	EMS Procedure	4.6
	Effective Date	
	Subject	Administration Review

Purpose The purpose of this procedure is to document the process and primary agenda of issues to be included in the Administration Review meetings for evaluating the organization's EMS. The Administration Review process is intended to provide a forum for discussion and improvement of the EMS and to provide management with a vehicle for making any changes to the EMS necessary to achieve the organization's goals.

Step 1 The EMS Manager is responsible for scheduling and conducting a minimum of two Administration Review meetings during each 12-month period. The EMS Manager is also responsible for ensuring that the necessary data and other information are collected prior to the meeting.

Step 2 At a minimum, each Administration Review meeting will consider the following:

- The suitability, adequacy and effectiveness of the environmental policy.
- The suitability, adequacy and effectiveness of the environmental objectives (as well as the organization's current status against these objectives)
- The overall suitability, adequacy and effectiveness of the EMS
- The status of corrective and preventive actions and the results of any EMS audit conducted since the last Administration Review meeting
- The suitability, adequacy and effectiveness of training efforts
- The results of any action items from the previous Administration Review meeting

Step 3 Minutes will be taken of the Administration Review. These meeting minutes will include, at a minimum, a list of attendees, a summary of key issues discussed, and any action items arising from the meeting.

Step 4 A copy of the meeting minutes will be distributed to attendees and any individuals assigned action items. A copy of the meeting minutes will be retained on file.

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Continual Improvement

You now know all the EMS components and hopefully have a good beginning to your EMS. Remember, it all starts with identifying your hospital's environmental aspects and impacts, determining which are most significant, and then identifying performance-based objectives and targets. Operational controls such as work instructions help achieve these objectives and targets and minimize significant impacts. Monitoring and measurement asks you to track your progress against both of these, making sure you are making positive environmental progress. Compliance auditing checks your performance against one component of environmental performance--your regulatory requirements. Your EMS audits are different from your compliance audits. EMS audits drive continual improvement by checking the system's performance against how you said the system would work and, in the case of an ISO 14001-aligned EMS, against the ISO 14001 standard. Audit findings you address through corrective/preventive action are opportunities for improvement and help improve your system and environmental performance. As you accomplish objectives and targets, reconsider your list of aspects. It is a good source of ideas for new objectives and targets, particularly if you are updating the list to reflect changes in your hospital's activities, products, and services. This drives continual improvement.

Continual improvement is one of the key differentiators of an EMS from the compliance-based approach to environmental management. Remember the concept of continual improvement as you start your system. Your system does not have to be 100% perfect out of the gate. There will be things you want to change and improve. Your EMS audits can help identify these opportunities. EMS audits will likely focus more on documentation and things to fix related to the system, but as your system matures, you should see your audits shift towards assessment of actual environmental performance. This is key. The system is a means to the end of improved environmental performance, not an end in and of itself.

Greater employee involvement, particularly beginning with management, is a second key differentiator of an EMS-based approach to environmental management. Without employee and top management involvement and support, the EMS will not generate significant environmental improvement or better results over the current management system. Employees and

management can be a source of direction for sustainable improvement and long-term value creation.

Organizations are discovering that their investments in EMSs are leading to improved environmental performance and compliance with benefits for both the environment, hospital, and surrounding community. We hope this manual serves as a useful resource in EMS implementation at your hospital and that you see the same rewards from an EMS as we have seen in many other organizations.

Resources

General Pollution Prevention Resources

Articles/Periodicals

"The Mercury Sphygmomanometer Should Be Abandoned Before it is Proscribed." Journal of Human Hypertension. Volume 14, pages 31 through 36. N.K. Markandu, F. Whitcher: A.Arnold and C.Carney.

"Pollution Prevention Review: Special Focus: P2 and Hospital Waste." John Wiley & Sons, Inc. Volume 11, Number 3, Summer 2001.

Books

Nadakavukaren, Anne. Our Global Environment: A Health Perspective. 1995. A comprehensive survey of the major environmental issues facing healthcare industry. Written in easy to understand language, with dual emphasis on the ecological impact of human activities with specific issues of personal and community health.

Check Lists

Environmental Self-Assessment for Health Care Facilities. New York State Department of Environmental Conservation Pollution Prevention Unit. February, 2000.
A quick and easy checklist of pollution prevention measures for health care facilities.

Fact Sheets

Best Management Practices for Hospitals and Medical Facilities. Palo Alto Regional Water Quality Control Plant. Ken Torke. September 1994. These best management practices encompass the metal pollutants of concern in hospitals from the South San Francisco Bay Area.

Case Studies in Hospital Solid Waste Reduction and Recycling: Reusable Totes, Blue Bag Wrap Recycling, and Composting: Environmental Best Practices for Health Care Facilities. Spring 2002. U.S. EPA. Contains three hospital case studies covering reusable totes, blue sterile wrap and plastic film recycling, and composting.

Eliminating Mercury in Hospitals: Environmental Best Practices for Health Care Facilities. Spring 2002. U.S. EPA. Excellent fact sheet outlining sources of mercury in hospitals,efficacy and cost data for mercury-free sphygomanometers, and three case studies summarizing successes, costs and lessons learned by hospitals accomplishing mercury reduction.

Replacing Ethylene Oxide and Glutaraldehyde with Environmentally Preferrable Sterilants/Disinfectants: Environmental Best Practices for Health Care Facilities. Spring 2002. U.S. EPA. Contains case studies on hospitals reducing use of ethylene oxide and glutaraldehyde.

Using Microfiber Mops in Hospitals: Environmental Best Practices for Health Care Facilities. Spring 2002. U.S. EPA. Provides focus on often overlooked aspect of hospital pollution prevention: janitorial cleaning products. Hospital case studies provide cost data from water and chemical savings associated with switching to microfiber mops in hospitals. Labor savings included.

Guides

Environmental Management Guide for Small Laboratories. U.S. EPA Small Business Division. Washington, DC. May 2000.

Guide to Mercury Assessment and Elimination in Healthcare Facilities (www.getf.org/file/toolmanager/O16F8459.pdf) Medical Waste Management Program, Department of Health Services: State of California. September, 2000.

Guide to Pollution Prevention: Selected Hospital Waste Streams; Risk Reduction Engineering Laboratory. The Center for Environmental Research Information, June 1990, EPA/625/7/-90/009.

Guidebook for Hospital Waste Reduction Planning and Program Implementation. American Society for Healthcare Environmental Services of the American Hospital Association. Chicago, IL. 1996.

Mercury Pollution Prevention in Healthcare. National Wildlife Federation. Guy Williams. 1997. A guide to help hospitals and their employees in their effort to become mercury free.

Mercury: In Your Community and the Environment. Wisconsin Department of Natural Resources. October, 1998.

NYC WasteLe$$: Hospital Waste Prevention and Energy Conservation Guidance Document. City of New York Department of Sanitation, U.S. EPA, New York State Energy Research and Development Authority. February 2001.

2000 PBT Program Accomplishments. Office of Pollution Prevention and Toxics. U.S. EPA. EPA-742-R-01-003. November 2001.

Pollution Prevention Guide for Hospitals (excluding medical wastes), California Environmental Protection Agency, Department of Toxic Substances Control, Office of Pollution Prevention and Technology Development, May 1998.

Manuals

An Organizational Guide to Pollution Prevention. U.S. EPA. Office of Research and Development. EPA/625/R-01/003. August 2001.

Code Green P2 Strategies for Health Care. (www.cornet.nf.ca/web/acapha/projects/documents/hospital_book.pdf) This manual provides hospitals a good overview of important pollution prevention areas based on Canadian resources.

Reducing Mercury Use in Health Care: Promoting a Healthier Environment A "How-to" Manual, Monroe County Department of Health and the Monroe County Department of Environmental Services, NY. Manual addresses how to establish a mercury pollution prevention program in hospitals, a list of mercury-containing products and associated best management practices, and case studies of successful hospital mercury reduction efforts.

U.S. EPA Buy Clean Training Manual for Eastern Kentucky School Districts. Developed by the Kentucky Pollution Prevention Center. October 2001.

Waste Management Strategies for Hospitals and Clinical Laboratories. Pollution Prevention Program, North Carolina Dept. of Environment, Health, and Natural Resources. May 1992.

Writing a Waste Reduction Plan for Health Care Organization. The University of Tennessee Center for Industrial Services. This handbook was designed to help your hospital comply with the Tennessee Hazardous Waste Reduction Act of 1990, Resource Conservation and Recovery Act (RCRA), and help you identify and assess pollution prevention and waste reduction options.

Reports

HealthSystem Minnesota Mercury Reduction. Holly J. Baron. Minnesota Technical Assistance Program. 2000.

Websites

American Hospital Association (www.aha.org).

California Department of Health Services, Medical Waste Management Program. (http://www.dhs.ca.gov/ps/ddwem/environmental/med_waste/medwasteindex.htm). This web page provides guidelines for proper handling and disposal of medical waste in California.

The Candadian Centre for Pollution Prevention (http://www.c2p2online.com)'s Healthcare Environet is an excellent hospital resource. Healthcare Environet offers information on management tools including audits, environmental management systems, health and safety programs, pollution prevention plans and emergency response plans;

numerous case studies; and networks and programs to keep connected with environmental practitioners and activities in the health care sector.

The Canadian Coalition for Green Healthcare (http://www.greenhealthcare.ca) includes case studies, an environmentally preferred list of PVC-free and mercury suppliers, and links to additional green health care web sites.

Complianceinfo.com provides compliance news, newsletters, and other resources to covering a wide variety of general hospital compliance issues. The website address is www.complianceinfo.com

Environmental Working Group (www.ewg.org) The Environmental Working Group (EWG) is a not-for-profit environmental research organization dedicated to improving public health and protecting the environment by reducing pollution in air, water and food.

Health Care Case Studies in Oregon. (www.deq.state.or.us/wmc/solwaste/cwrc/cstudy/healthcare.html). Several documented cases of pollution prevention and cost savings in Oregon.

The Healthcare Compliance Association's (http://www.hcca-info.org/) mission is to champion ethical practice and compliance standards in the health care community and to provide the necessary resources for compliance.

Health Care Resource Conservation Coalition (www.albanyonline.com/hrcc/). This site provides resources to exchange information and establish best management practices in the relating to healthcare waste

Health Care Without Harm (http://www.noharm.org). This website features new resources including 'Going Green: A Resource Kit for Pollution Prevention in Health Care" and links to PVC and mercury publications, videos and web resources.

Hospitals for a Healthy Environment (www.h2e-online.org) is a voluntary partnership of the US EPA, American Hospital Association, Health Care Without Harm, and the American Nurses Association pledged to eliminate mercury use by 2005 and reduce all hospital waste by 50% by 2010. The website offers excellent resources to achieve these objectives including lists of mercury-containing items, persistent bioaccumulative toxins, green cleaning products, and links to pollution prevention providers, consultants, mercury recyclers, and many other resources.

Kentucky Hospital Association (www.kyha.com). The KY Hospital Association provides information for Kentucky Hospitals.

Medical and Scientific Community Organization Mercury Work Group (http://www.masco.org/mercury/index.htm) has excellent mercury management and mercury-free resources including a mercury management guidebook and a searchable database of mercury-free products.

Minnesota Technical Assistance Program (http://www.mntap.umn.edu/). This web page offers answers to questions regarding disposal of some common medical-related waste streams.

The Nightingale Institute for Health and the Environment (www.nihe.org) web page provides resources including manuals, news, tools for environmentally responsible nurses, and a new tool for environmentally preferable health care purchasing called the HCEPT Tool.

Northwest Guide to Pollution Prevention by the Healthcare Sector (http://www.pprc.org/pprc/pubs/topics/healthcare.html). This site has an extensive list of resources in one place.

PBT/mercury reduction resources are accessible through www.kppc.org under Technical Resource|Links|P2 for Healthcare Organizations.

Pollution Prevention Tips for Healthcare Providers. (www.montana.edu/~wwwated/healthcare.htm). This Montana Pollution Prevention Program lists tips, additional resources, and more information about pollution prevention.

Small Business Assistance Programs (SBAPs) were created as a result of the Clean Air Act Amendments of 1990 requirement that all States develop a program to assist small businesses in meeting the requirements of the Act. Since then, most of these programs have expanded to provide assistance in other environmental areas, including waste and waste issues. SBAPs provide free, non-regulatory environmental compliance and pollution prevention assistance to small businesses. The program provides small businesses with partnership-based compliance support, education, outreach and advocacy. This EPA web link (http://www.epa.gov/reg3ecej/compliance_assistance/hospitals.htm) provides a listing of key state contacts for compliance assistance.

Small Business Environmental Assistance Home Page (http://www.smallbiz-enviroweb.org/ pubsector.asp). Click on 'hospitals/medical' in the search box. While many articles are dental are pollution prevention-related, there are several focusing on compliance and disposal options associated with medical waste.

The Sustainable Hospitals website (www.sustainablehospitals.org) provides technical support to the healthcare industry for selecting products and work practices that reduce occupational and environmental hazards, maintain quality patient care, and contain costs.

U.S. EPA's Environmentally Preferable Purchasing (EPP) website (www.epa.gov/oppt/epp) is an excellent resource. Among the tools on this web page include EPP general training tools, a database of information of contacts for environmentally preferable products and services, and a practices guide for 'greener' contracts.' The best one-stop shop for any and all EPP needs.

U.S. EPA's Mercury web Site. (www.epa.gov/mercury). This site provides background information, Agency actions taken on mercury, fish advisory information, as well as downloadable research and technical materials.

U.S. EPA's Mercury in Medical Facilities. **(**www.epa.gov/seahome/mercury/src/outmerc.htm). This is an interactive environmental education software program developed jointly by Purdue University and the U.S. EPA to provide information on the proper handling and disposal of mercury wastes produced by medical facilities.

U.S EPA Office of Solid Waste (http://www.epa.gov/epaoswer/osw/ stateweb.htm) This web page provides link to state solid waste programs.

U.S. EPA's Office of Pollution Prevention and Toxics (OPPT) PBT Program Web site. www.epa.gov/pbt. A wealth of information on EPA initiatives, goals, regulatory activities, voluntary partnerships, and links to technical materials and environmental/health effects associated with PBT's.

U.S. EPA sponsors approximately 89 **hotlines** and clearinghouses that provide free and convenient avenues to obtain assistance with environmental requirements. Key hotlines that may be of interest to include the following:

RCRA/UST/CERCLA Hotline	(800) 424-9346
Toxics Substances and Asbestos Information	(202) 554-1404
Stratospheric Ozone/CFC Information	(800) 296-1996
Clean Air Technical Center	(919) 541-0800

Waste Reduction Activities for Hospitals. (www.ciwmb.ca.gov/BIZWASTE/factsheets/hospital.htm). This site provides extensive information in a number of areas related to waste reduction activities for hospitals as well as many valuable statistics encouraging for hospitals success in waste reduction.

The Waste Reduction Resource Center (http://wrrc.p2pays.org/industry/hospital.htm) provides resources for hospitals and medical facilities including web sites, manuals, articles and reports, fact sheets, video tapes, and case studies.

Waste Reduction Tips for Healthcare/Medical. (www.deq.state.or.us/wmc/solwaste/cwrc/wrstrategy/healthcarestrategy.html) This site provides waste reduction tips in the pharmacy, x-ray, custodial, purchasing, supplies, and cafeteria. There are also recycling and composting tips.

Energy Efficiency Resources

Hospitals exhibit unique energy demands and specifications. Not only do hospitals operate 24 hours a day, 7 days a week, but also must typically heat and cool very large areas. Hospitals also have energy-intensive activities such as medical equipment, laundry and kitchen services, sterilization, and use of large quantities of hot water. Fulfilling these needs can consume large amounts of energy; consequentially, energy offers very worthwhile cost savings opportunities. Here are a few resources focused on hospital energy efficiency.

Energy Efficiency in Health Care Facilities: A Hot Opportunity to Chill. Philip J. Kercher. September 1999. Available through the American Hospital Association (800)-242-2626, or visit the American Hospital Association web site at www.ahaonlinestore.com. Manual describes preventative maintenance, performance contracting, and energy management teams as component of successful energy management. Reviews three programs along with costs and benefits.

Managing Utility Cost in a Health Care Facility. Michael Brian Cotton. August, 1999. Available through the American Hospital Association (800) 242-2626 or visit the American Hospital Association web site at www.ahaonlinestore.com. Manual describes energy controls and management opportunities available to hospital facility managers.

Energy Savings in Hospitals. Caddett Analyses Series 20. June 1996. Available for purchase through the American Council for an Energy Efficient-Economy. http://www.aceee.org/index.htm

EnergyStar for Hospitals. Among the useful tools at this website are energy and water efficiency case studies. Also available is a bench mark tool for Cancer Care, Rehabilitation, and Psychiatric Centers, and Skilled Nursing Facilities. The tool is an easy way to evaluate and compare energy performance against others across the country.

Environmental Management Accounting

Guides, Articles, and Manuals

Accounting and Capital Budgeting for Pollution Prevention. Martin A. Spitzer, Robert Pojasek, Francis L. Robertaccio, Judith Nelson. Pollution Prevention in South Carolina. Winter 1996.

An Introduction to Environmental Accounting As A Business Management Tool: Key Concepts and Terms. U.S. EPA, Design for the Environment Program, Environmental Accounting Project.

Set Up a Waste Accounting System to Track Pollution Prevention. Chemical Engineering Process. Donald C. Nizolek and W. Corey Trench, Mary E. McLearn. August 1994.

Total Cost Assessment: Accelerating Industrial Pollution Prevention Through Innovation Project Financial Analysis. U.S. EPA Office of Pollution Prevention. May 1992.

Websites

Environmental Management Accounting Network. (www.uni-lueneburg.de/eman/).

Environmental Management Accounting Research and Information Center. (www.emawebsite.org/).

Environmental Management Indicators and Environmental Accounting. (www.kirin.co.jp/english/company/env/p12_13.html).

EPA Victoria, Australia. Environmental Management Accounting Project. (http://www.epa.vic.gov.au/Programs/ema.asp).

Environmental Management Initiatives: Minolta. (www.minolta.com/pdf/env_11-16.pdf).

Tellus Institute: Business and Sustainability Group, Introduction to Environmental Management Accounting. (http://www.tellus.org/b&s/EMA_intro.html).

United Nations Sustainable Development Environmental Accounting Initiative. (http://www.un.org/esa/sustdev/estema1.htm).

U.S. EPA's Design for the Environment. (http://www.epa.gov/opptintr/dfe/index.htm).

Kentucky Pollution Prevention Center Environmental Management Systems (EMS) Auditing Tool

Date:_____ Facility Name:_____
Audit Team:_____ Facility Location:_____
_____Facility Representative:_____
_____
_____
Lead Auditor:_____

Opening meeting:

- Brief introduction and background of auditors
- Review scope (this plant)
- Intent is to collect objective evidence to assess whether organization has a EMS.
  - Does the system conform to the ISO 14001 standard?
  - Is the system documented where required?
  - Does the work agree with the documented/undocumented system?
  - Do records show the system works?
- Review audit plan and timetable. There will be a closing meeting each day of the audit to review the sections covered. At the end of the audit, there will be a final closing meeting with a preliminary written report for the plant before the audit team leaves.
- Establish communication links between audit team and auditee.
- Confirm needed resources and facilities are available.
- Confirm date and time of closing meeting.
- Review relevant site safety and emergency procedures with audit team.

<u>ISO 14001 Section 4.2 - Environmental Policy</u>: Top management shall define the organization's environmental policy and ensure that it: a) is appropriate to the nature, scale and environmental impacts of its activities, products or services; b) includes a commitment to continual improvement and prevention of pollution; c) includes a commitment to comply with relevant environmental legislation and regulations, and with other requirements to which the organization subscribes; d) provides the framework for setting and reviewing environmental objectives and targets; e) is documented, implemented, maintained and communicated to all employees; f) is available to the public.

4.2 Environmental policy

This section requires the organization's top management to define, document, maintain, implement, and communicate an environmental policy that includes a commitment to continual improvement, prevention of pollution, and a commitment to comply with legal and other requirements.

1.1 Has top management defined the organization's environmental policy?

Note(s)	Observations and Recommendations	Score
Who is top management? Has it been defined in system? Objective evidence includes meeting minutes showing top management attendees and policy review and approval. Signature(s) by top manager(s) on written policy.		

1.2 Is the policy appropriate to the nature and scale of the organization's activities, products, and services?

Note(s)	Observations and Recommendations	Score
Corporate policies handed down to the facility may not be appropriate to organization's activities, products, or services.		

1.3 Check to ensure the policy includes:

a) A commitment to continual improvement.

b) A commitment to prevention of pollution.

c) A commitment to comply with relevant environmental legislation and regulations and other requirements to which the organization subscribes, that are applicable to the environmental aspects of its activities, products, or services?

Note(s)	Observations and Recommendations	Score

1.4 Does the policy provide a framework for setting and reviewing the organization's environmental objectives and targets?

Note(s)	Observations and Recommendations	Score
Score 0=environmental policy does not guide setting of objectives and targets. Policy written in a way that leaves readers confused. Score 1=Policy is specific enough to guide setting of environmental objectives and targets for most aspects; most of policy understandable to interested parties Score 2=policy clear and specific to guide setting of environmental objectives and targets; policy understandable to interested parties.		

1.5 Is the policy documented?

Note(s)	Observations and Recommendations	Score

1.6 Is the policy implemented and maintained?

Note(s)	Observations and Recommendations	Score
Is there evidence of discussion of possible need to change policy? Organization may review policy and progress toward objectives and targets annually as part of management review (4.6). Review meetings may have documented agendas and minutes indicating preventive and corrective action.		

1.7 Is the policy communicated to all employees?

Note(s)	Observations and Recommendations	Score
Objective evidence that the policy has been communicated would include employee answers to questions under 4.4.2 training, awareness, and competence. Others include documented training agendas and course materials, policy postings on bulletin boards throughout production and common areas, electronic access from workstations, publications, hardhat stickers, policy on back of ID badges.		

1.8 How do you make the policy available to the public?

Note(s)	Observations and Recommendations	Score
Objective evidence would include policy posted in lobby, on brochure in lobby, newspaper clippings, handouts at community events, etc.		

<u>ISO 14001 4.3 - Planning: Section 4.3.1 - Environmental Aspects</u>: The organization shall establish and maintain (a) procedure(s) to identify the environmental aspects of its activities, products or services that it can control and over which it can be expected to have an influence, in order to determine those which have or can have significant impacts on the environment. The organization shall ensure that the impacts related to these significant aspects are considered in setting its environmental objectives. The organization shall keep this information up-to-date.

4.3.1 Environmental aspects

This section requires the organization to establish and maintain a procedure for the identification of environmental aspects that could have a significant impact on the environment. Aspect information is required to be kept up-to-date.

2.1 Does the organization have a procedure to identify environmental aspects of plant's activities, products and services, which it can control and have influence over?

Note(s)	Observations and Recommendations	Score
1) If no written procedure present, ask how organization identifies its aspects and assess whether the process could be duplicated in a controlled and consistent manner. 2) Relevant records demonstrating application of procedure include aspect identification worksheets, meeting minutes from departmental teams identifying environmental aspects, etc. 3) Are there design, procurement, distribution, product use and end-of-life issues mentioned in the aspects procedure?		

2.2 How do you determine significance of aspects/impacts?

Note(s)	Observations and Recommendations	Score
Was significance of aspects determined in conformance with the procedure?		

2.3 Have environmental aspects which have significant environmental impacts been considered in setting objectives?

Note(s)	Observations and Recommendations	Score

2.4 Is aspect information up-to-date?

Note(s)	Observations and Recommendations	Score
1) How frequently is it reviewed (at least annually)? How are new activities, products, and services handled within the EMS? 2) Look to see review is occurring as stated and as often as stated. Examples of objective evidence includes records of periodic review. This review is commonly done by environmental staff or functional areas or Management Review (4.6). 3) New activities, products, and services may be handled through periodic reviews performed by environmental staff or functional areas or Management Review (4.6).		

<u>ISO 14001 4.3 Planning: Section 4.3.2 - Legal and other requirements</u>: The organization shall establish and maintain a procedure to identify and have access to legal and other requirements which the organization subscribes, that are applicable to the environmental aspects of its activities, products or services.

4.3.2 Legal and other requirements

Section 4.3.2 requires the organization to have procedures in place to identify and have access to legal and "other" requirements to which the organization subscribes. 'Other' requirements include industry codes of practice, voluntary waste minimization/pollution prevention programs such as Project XL, and corporate policies.

3.1 Does the organization have a procedure to identify/have access to legal requirements that relate to environmental aspects of organization's activities, products, and services?

Note(s)	Observations and Recommendations	Score
1) If no written procedure present, ask how organization identifies its legal requirements and assess whether the process could be duplicated in a controlled and consistent manner. 2) Choose a requirement that the organization determined was not applicable. Ask them to show how they made this determination. 3) Objective evidence that legal requirements have been identified may include a list/matrix of applicable regulatory requirements. Pick 2 or 3 legal requirements and ask auditee to show regulatory text that is applicable. Is it done how the procedure says it would be done? Objective evidence for access to legal requirements includes corporate counsel, ongoing subscriptions to BNA, CD-ROM's, Internet bookmarks, corporate headquarters legal staff, CFRs present during audit, and EPA compliance audits and results.		

3.2 Does the organization have a procedure to identify/have access to other requirements (relating to environmental aspects of activities, products, services) to which the organization may subscribe?

Note(s)	Observations and Recommendations	Score

<u>ISO 14001 Section 4.3.3 - Objectives and Targets</u>: The organization shall establish and maintain documented environmental objectives and targets, at each relevant function and level within the organization. When establishing and reviewing its objectives, an organization shall consider the legal and other requirements, its significant environmental aspects, its technological options and its financial, operational and business requirements, and the views of interested parties. The objectives and targets shall be consistent with the environmental policy, including the commitment to prevention of pollution.

4.3.3 Objectives and targets

Section 4.3.3 specifies several factors that must be considered for setting objectives and targets. These include, significant environmental aspects, legal and other requirements, views of stakeholders, technology, financial, operational and other business issues. ISO 14001 also requires the objectives and targets to link to the environmental policy, and be established at every relevant function and level in the organization.

4.1 Does the organization have documented objectives and targets?

Note(s)	Observations and Recommendations	Score

4.2 Are the objectives and targets established at each relevant function and level within the organization?

Note(s)	Observations and Recommendations	Score
This requirement is most commonly addressed in the documentation through a statement indicating that objectives and targets apply throughout the organization. Objective evidence will come through questioning employees on their knowledge.		

4.3 How were each of the following considered in establishing and reviewing objectives:

a) Legal requirements?

b) Other requirements?

c) Significant environmental aspects?

d) Technological options?

e) Financial requirements?

f) Operational requirements?

g) Business requirements?

h) Views of interested parties?

Note(s)	Observations and Recommendations	Score

4.4 Who are the organization's external interested parties? How did you consider their views in setting your objectives and targets?

Note(s)	Observations and Recommendations	Score

4.5 Has responsibility for establishing and maintaining documented objectives and targets been assigned?

Note(s)	Observations and Recommendations	Score
1) Tell me how you review your objectives and targets. How frequently are they reviewed? Who reviews and approves the objectives and targets? 2) Look to see review is occurring as stated and as often as stated. Examples of objective evidence includes records of periodic review of the procedure. This review is commonly done by environmental staff or Management Review (4.6) but frequency of review should be specified.		

4.6 Are objectives and targets consistent with the environmental policy, including commitment to prevention of pollution?

Note(s)	Observations and Recommendations	Score

4.7 Is reasonable progress being made in accomplishing objectives and targets?

Note(s)	Observations and Recommendations	Score
1) Review quarterly or annual reports on objectives and targets when auditing Management Review 4.6. Have they been reviewed by management? Are corrective actions being implemented that improve the chances of meeting targets for the objectives? 2) Progress toward objectives and targets may provide objective evidence of 4.2 Environmental Policy continual improvement.		

4.8 As objectives and targets are met, are new ones established?

Note(s)	Observations and Recommendations	Score
1) As objectives and targets are achieved, are new ones established? This would be objective evidence for continual improvement under 4.2(b) and (d).		

<u>ISO 14001 Section 4.3.4 - Environmental Management Program(s)</u>: The organization shall establish and maintain (a) program(s) for achieving its objectives and targets. It shall include: a) designation of responsibility for achieving objectives and targets at each relevant function and level of the organization; b) the means and time frame by which they are to be achieved. If a project relates to new developments and new or modified activities, products or services, program(s) shall be amended where relevant to ensure that environmental management applies to such projects.

4.3.4 Environmental management program(s)

This section requires the organization to establish programs for achieving its objectives and targets. The program requirement specifically includes designation of responsibility at each relevant function and level in the organization, and the means and time frame by which these objectives are to be achieved. The program is also required to address new activities, products, or services.

5.1 Has the organization established an environmental management program(s) for achieving its objectives and targets?

Note(s)	Observations and Recommendations	Score

5.2 Has responsibility for achieving objectives and targets at each relevant function and level of the organization been established in the EMP?

Note(s)	Observations and Recommendations	Score
Pick 2 or 3 objectives and ask auditee to describe which plant areas are affected by each target/objective.		

5.3 Has the organization specified the time frames by which objectives and targets will be achieved?

Note(s)	Observations and Recommendations	Score
Do key personnel know relevant timeframes for achieving objectives and targets? This can be objective evidence of 4.4.2 (d) and 4.4.3 (a).		

5.4 Has the organization specified how objectives and targets will be achieved?

Note(s)	Observations and Recommendations	Score
Objective evidence can include work instructions. Objective evidence of financial means would include budgets for EMPs, line item in accounting budget for EMS or EMP expenditures, staffing plans and vacancies in the environmental programs.		

5.5 How is progress toward objectives and targets measured?

Note(s)	Observations and Recommendations	Score

5.6 Does the organization maintain/review programs for achieving objectives and targets?

Note(s)	Observations and Recommendations	Score
This review may be mentioned under 4.3.3 Objectives and targets. Examples of objective evidence include records of periodic review. This review is commonly done by environmental staff or Management Review (4.6). Look to see how often review will be conducted.		

5.7 When new or modified activities, products or services are implemented, how do you ensure that environmental management applies to these projects?

Note(s)	Observations and Recommendations	Score

<u>ISO 14001 4.4 Implementation and Operation: Section 4.4.1 - Structure and Responsibility</u>: Roles, responsibilities and authorities shall be defined, documented and communicated in order to facilitate effective environmental management. Management shall provide resources essential to the implementation and control of the environmental management system. Resources include human resources and specialized skills, technology and financial resources. The organization's top management shall appoint (a) specific management representative(s) who, irrespective of other responsibilities, shall have defined roles, responsibilities and authorities for: a) ensuring that environmental management system requirements are established, implemented and maintained in accordance with this standard; b) reporting on the performance of the environmental management system to top management for review and as a basis for improvement of the environmental management system.

4.4.1 Structure and responsibility

This section requires the organization to formally and clearly define, document, and communicate environmental responsibilities, and to assign a management representative with responsibility for overseeing the overall implementation of the EMS.

6.1 Are environmental roles (what has to get done), responsibilities (who gets it done), and authorities (who sees that it gets done) documented? If not documented, have environmental roles been defined?

Note(s)	Observations and Recommendations	Score

6.2 Are environmental roles (what has to get done), responsibilities (who gets it done), and authorities (who sees that it gets done) communicated?

Note(s)	Observations and Recommendations	Score

6.3 Have adequate resources (human, skills, technology, and financial) been provided for the implementation and control of the EMS?

Note(s)	Observations and Recommendations	Score
How are human, financial, and technological resources allocated/provided to the EMS? Objective evidence of financial support would include line item in accounting budget or an account number for EMS expenditures.		

6.4 Has top management appointed an EMS management representative?

Note(s)	Observations and Recommendations	Score
Be sure to look for documentation/record of appointment of top management representative (e.g., in a letter or memo of commitment from President/General Manager or an organization chart that shows roles and responsibilities).		

6.5 Do the roles and responsibilities of the management's representative(s) fulfill the duties described in Section 4.4.1 a) and b) of the Standard?

Note(s)	Observations and Recommendations	Score
Top management shall appoint representatives who ensure EMS requirements are established, implemented, and maintained" (a) and who report the performance of the EMS to top management (b). See 6.4 above.		

<u>ISO 14001 Section 4.4.2 - Training, Awareness and Competence</u>: The organization shall identify training needs. It shall require that all personnel, whose work may create a significant impact upon the environment, receive appropriate training. It shall establish and maintain procedures to make its employees or members at all relevant levels aware of: a) the importance of conformance with the environmental policy and procedures and with the requirements of the environmental management system; b) the significant environmental impacts, actual or potential, of their work activities and the environmental benefits of improved personal performance; c) their roles and responsibilities in achieving conformance with the environmental policy and procedures, and with the requirements of the environmental management system including emergency preparedness and response requirements; d) the potential consequences of departure from specific operating procedures.

Personnel performing tasks which can cause significant environmental impacts shall be competent on the basis of appropriate education, training and/or experience.

4.4.2 Training, awareness, and competence

This section requires the organization to evaluate and implement specific training activities for those personnel at each relevant function and level, whose job activities could have a significant impact on the environment. Training is required to include general environmental awareness, and job specific training.

7.1 Has the organization identified what job functions may have a significant impact on the environment? How does organization identify EMS training needs?

Note(s)	Observations and Recommendations	Score
1) Sample-check that personnel (preferably a key line operator, manager, and supervisor) whose work can have a significant impact on the environment have been identified. 2) Objective evidence can include lists of positions within the organization and associated training needs, procedures for training, as well as organization charts. 3) Documentation should link personnel whose work can have a significant impact on the environment to the training they receive. 4) Was the training delivered? Look at training records (4.5.3), agendas, class materials/training curricula to verify what was covered in the training.		

7.2 Has the organization established a procedure to make its employees aware of the following?

a) The importance of conformance with the environmental policy, procedures, and requirements of the EMS.

b) The significant actual and potential impacts of their work and the benefits of improved personal performance.

c) Their roles and responsibilities in achieving conformance with the environmental policy, procedures, EMS, and emergency preparedness and response procedures.

d) The potential consequences of departure from specified operating procedures.

Note(s)	Observations and Recommendations	Score

7.3 How does the organization assess competence of personnel whose work can cause significant environmental impacts?

Note(s)	Observations and Recommendations	Score

7.4 Have training needs for the EMS representative been determined?

Note(s)	Observations and Recommendations	Score
Verify whether the EMS representative received this training? Ask for EMS representative's training records (4.5.3).		

7.5 Who else provides training that is required? How were they trained or qualified to be a trainer?

Note(s)	Observations and Recommendations	Score
a) Ask to see objective evidence of training received and competency. b) If experience is called out as the basis of competency, follow up with questions: how many years of experience required? How do you decide 'how much' experience is enough? What qualifies as experience?		

<u>ISO 14001 Section 4.4.3 – Communication</u>: With regard to its environmental aspects and environmental management system, the organization shall establish and maintain procedures for: a) internal communication between various functions and levels of the organization; b) receiving, documenting and responding to relevant communication from external interested parties.

The organization shall consider processes for external communication on its significant environmental aspects and record its decision.

4.4.3 Communication

This section requires the organization to establish and maintain procedures for communicating its aspects and elements of the environmental management system to external interested parties. It also requires the organization to consider a process for communicating to external parties about its significant aspects, and record its decision.

8.1 Is there a procedure for internal communication of the EMS and the environmental aspects between the various levels and functions of the organization?

Note(s)	Observations and Recommendations	Score
1) If yes, is communication occurred as indicated in the procedure? 2) Any of the following may be sample items that a facility may point to as examples of how internal communication occurs: training-related materials, agendas, sign-up sheets, and overheads from environmental meetings. 3) A common nonconformance is that documented internal communications were required under the Standard but transmitted verbally.		

8.2 Is there a procedure for receiving, documenting and responding to communications from external interested parties regarding the organization's environmental aspects and EMS?

Note(s)	Observations and Recommendations	Score
1) There are three things to look for: how it *receives*, *documents*, and *responds* to the request. 2) Have you received any external requests for information? If yes, ask/look to see how these have been handled in the system. Is it how they said it would be handled? Was it documented? Responded to in the required or reasonable period of time? One test would be to call ahead to ask for significant aspects. When on-site, verify that your request has been handled within the system. A common example of an external request is a sister facility calling for information on the EMS.		

8.3 Has the organization has documented a decision as to whether or not it will communicate information on its aspects and EMS to external interested parties.

Note(s)	Observations and Recommendations	Score

<u>ISO 14001 Section 4.4.4 - Environmental Management System Documentation</u>: The organization shall establish and maintain information, in paper or electronic form, to: a) describe the requirements of the management system and their interaction, b) provide direction to related documentation.

4.4.4 Environmental management system documentation

This section requires the organization to maintain documentation (electronically or written) which describes the core elements of the EMS, their interaction, and directions to related documentation.

9.1 Is there documentation describing the core elements of the EMS and their interaction?

Note(s)	Observations and Recommendations	Score
There are a variety of ways to show interaction among the elements: references within the procedures (probably most common), flowcharts, procedural matrices, EMS table of contents or Master Document Control List.		

9.2 Does the scope of the EMS documentation and related documents cover all elements of the ISO 14001 standard? Does documentation provide direction to related documents?

Note(s)	Observations and Recommendations	Score
Related documentation may include internal standards and operational procedures, process information, site emergency plans, etc.		

<u>ISO 14001 Section 4.4.5 - Document Control</u>: The organization shall establish and maintain procedures for controlling all documents required by this standard to ensure that: a) they can be located; b) they are periodically reviewed, revised as necessary and approved for adequacy by authorized personnel; c) the current versions of relevant documents are available at all locations where operations essential to the effective functioning of the system are performed; d) obsolete documents are promptly removed from all points of issue and points of use or otherwise assured against unintended use; e) any obsolete documents retained for legal and/or knowledge preservation purposes are suitably identified. Documentation shall be legible, dated (with dates of revision) and readily identifiable, maintained in an orderly manner and retained for a specified period. Procedures and responsibilities shall be established and maintained concerning the creation and modification of the various types of documents.

4.4.5 Document control

This section requires the organization to establish and maintain procedures for controlling documentation related to the EMS.

This section is largely audited while looking at other system requirements.
Generally speaking, if a paper/reference is being used to answer an auditor question, to support the system or to communicate information regarding the system, it should be in document control and meet document control requirements.

10.1 Does the organization have a procedure for controlling documents required by ISO 14001?

Note(s)	Observations and Recommendations	Score

10.2 Does the procedure ensure that:

a) Documents are locatable?

b) Documents are periodically reviewed, revised as necessary, and approved for adequacy by authorized personnel?

c) Current versions of relevant documents are available at all locations where operations essential to the effective functioning of the EMS are performed?

d) Obsolete documents are promptly removed from all points of issue and use, or otherwise protected from unintended use?

e) Obsolete documents retained for legal and/or knowledge preservation purposes are suitably identified?

Note(s)	Observations and Recommendations	Score

10.3 Has responsibility for fulfilling document control responsibilities been assigned?

Note(s)	Observations and Recommendations	Score

10.4 Is documentation legible?

Note(s)	Observations and Recommendations	Score

10.5 Does documentation have dates of revision?

Note(s)	Observations and Recommendations	Score

10.6 Is documentation readily identifiable?

Note(s)	Observations and Recommendations	Score

10.7 Is documentation maintained in an orderly manner?

Note(s)	Observations and Recommendations	Score

10.8 Is documentation retained for a specific period?

Note(s)	Observations and Recommendations	Score

10.9 Are there assigned responsibilities for creating and modifying EMS documents?

Note(s)	Observations and Recommendations	Score

10.10 Is there/are there procedure(s) for creating and modifying EMS documents?

Note(s)	Observations and Recommendations	Score

<u>ISO 14001 Section 4.4.6 - Operational Control</u>: The organization shall identify those operations and activities that are associated with the identified significant environmental aspects, in line with its policy, objectives and targets. The organization shall plan these activities, including maintenance, to ensure that they are carried out under specified conditions by: a) establishing and maintaining documented procedures to cover situations where their absence could lead to deviations from the environmental policy and the objectives and targets b) stipulating operating criteria in the procedures; c) establishing and maintaining procedures related to the significant environmental aspects of goods and services used by the organization and communicating relevant procedures and requirements to suppliers and contractors.

4.4.6 Operational control

This section requires the organization to identify operations and activities that are associated with the significant aspects, then document procedures whenever the absence of documented procedures could result in deviations from the environmental policy and objectives and targets. All operational control procedures should have operating criteria spelled out. There should be procedure(s) for communicating applicable and relevant operational procedures and requirements to suppliers and contractors.

11.1 Has the organization identified operations and activities associated with its identified significant environmental aspects?

Note(s)	Observations and Recommendations	Score

11.2 Has the organization established documented work instructions and procedures to cover situations where their absence could lead to deviations from the environmental policy, objectives and targets?

Note(s)	Observations and Recommendations	Score
Sample several operations and activities associated with significant aspects. Verify that the procedures tell "how-to".		

11.3 Has the organization established operating criteria in the work instructions and procedures?

Note(s)	Observations and Recommendations	Score

11.4 Are relevant documented procedures available at locations where these operations and activities are performed?

Note(s)	Observations and Recommendations	Score
Is maintenance crew on spill response team? Is emergency preparedness and response procedure available at this workstation?		

11.5 Has responsibility for implementing these work instructions and procedures been assigned?

Note(s)	Observations and Recommendations	Score

11.6 Has responsibility for periodically reviewing and updating these work instructions and procedures been assigned?

Note(s)	Observations and Recommendations	Score
Tell me how you maintain the procedure. How frequently is it maintained/reviewed? Look to see review is occurring as stated and as often as stated. Examples of objective evidence include records of periodic review. This review is commonly done by environmental staff or Management Review (4.6) but frequency of review should be specified.		

11.7 Has the organization established and maintained procedure(s) related to the identifiable significant environmental aspects of goods and services used by the organization? How are these communicated to suppliers and contractors?

Note(s)	Observations and Recommendations	Score
1) Show me some of the relevant procedures and requirements you have for your suppliers and contractors. 2) Organization should have a procedure that identifies suppliers (i.e. those whose goods and services are related to significant aspects) and provides for communicating relevant procedures and requirements to these suppliers. 3) Record of this training/external communication could include mailing of aspect/impact/objectives and targets/sheet with signed confirmation back to organization.		

<u>ISO 14001 Section 4.4.7 - Emergency Preparedness and Response</u>: The organization shall establish and maintain procedures to identify potential for and respond to accidents and emergency situations, and for preventing and mitigating the environmental impacts that may be associated with them. The organization shall review and revise, where necessary, its emergency preparedness and response procedures, in particular, after the occurrence of accidents or emergency situations. The organization shall also periodically test such procedures where applicable.

4.4.7 Emergency preparedness and response

This section requires the organization to establish and maintain procedures for identifying and responding to potential accidents and emergency situations; preventing and mitigating associated environmental impacts. The organization shall review procedures especially after accidents and emergency, and revise procedures where necessary.

12.1 Has the organization established a procedure to identify the potential for accidents and emergency situations?

Note(s)	Observations and Recommendations	Score
Has the organization defined accidents and emergencies?		

12.2 Does the procedure address how the organization will respond to accidents and emergency situations so as to prevent and mitigate the associated environmental impacts?

Note(s)	Observations and Recommendations	Score
Objective evidence of how the organization would respond include referenced SPCC Plans, RCRA Hazardous Waste plans, Stormwater Pollution Prevention Plans, etc.		

12.3 Are emergency preparedness and response procedures available in applicable operational areas?

Note(s)	Observations and Recommendations	Score
Check during tour, while interviewing key employees.		

12.4 Are the procedures maintained, reviewed and updated regularly and when necessary, particularly after the occurrence of accidents or emergency situations?

Note(s)	Observations and Recommendations	Score
Have any accidents or emergencies occurred? If so, may want to see if organization reviewed its procedures. What would guide decision to review and update the procedure? Look at incident investigation results and corrective actions. If one of the potential accidents occurred, what would be the steps that would be followed for reviewing and revising the procedures.		

12.5 Does the organization periodically test these procedures where practicable? Has responsibility been assigned in these circumstances?

Note(s)	Observations and Recommendations	Score
Some organizations say: "The organization shall periodically test such procedures where practicable." How do you determine if it is practicable to test the procedure? If practicable, when were they last tested. Look for log of last test date and time.		

ISO 14001 4.5 Checking and Corrective Action: Section 4.5.1 - Monitoring And Measurement: The organization shall establish and maintain documented procedures to monitor and measure, on a regular basis, the key characteristics of its operations and activities that can have a significant impact on the environment. This shall include the recording of information to track performance, relevant operational controls and conformance with the organization's objectives and targets. Monitoring equipment shall be calibrated and maintained, and records of this process shall be retained according to the organization's procedures. The organization shall establish and maintain a documented procedure for periodically evaluating compliance with relevant environmental legislation and regulations.

4.5.1 Monitoring and measurement

This section requires the organization to establish and maintain documented procedures to monitor and measure the key characteristics of operations and activities that are related to the significant aspects. This should include a requirement for documented procedures for compliance auditing and monitoring equipment maintenance and calibration.

13.1 Has the organization established documented procedures to monitor and measure on a regular basis the key characteristics (as determined in 4.4.6) of its operations and activities that can have a significant impact on the environment?

Note(s)	Observations and Recommendations	Score
How do you monitor and measure operations and activities that can have a significant impact on the environment? What are the measurements you use that show you are making progress toward your objectives and targets?		

13.2 Does the procedure include requirements for recording information to track performance, relevant operational controls, and conformance with the organization's objectives and targets?

Note(s)	Observations and Recommendations	Score

13.3 Is there a procedure for calibrating and maintaining monitoring equipment?

Note(s)	Observations and Recommendations	Score

13.4 Are records of calibration and maintenance retained according to the organization's procedures?

Note(s)	Observations and Recommendations	Score

13.5 Has the organization established a documented procedure for periodically evaluating compliance with relevant environmental legislation and regulations?

Note(s)	Observations and Recommendations	Score

1) Procedure should specify how and when compliance will be evaluated.
2) Verify that compliance evaluations have been performed as described and at specified time intervals. Objective evidence includes internal and external compliance audit reports.

<u>ISO 14001 Section 4.5.2 - Nonconformance, Corrective and Preventative Action</u>: The organization shall establish and maintain procedures for defining responsibility and authority, for handling and investigating nonconformance, taking action to mitigate any impacts caused by non-conformances and for initiating and completing corrective and preventative action. Any corrective or preventative action taken to eliminate the causes of actual and potential non-conformances shall be appropriate to the magnitude of problems and commensurate with the environmental impact encountered.

4.5.2 Nonconformance and corrective and preventive action

This section of the ISO 14001 requires that the organization identify the causes of nonconformance, identify and implement the necessary corrective action, implement or modify controls necessary to avoid repeating the nonconformance, and record any changes in written procedures resulting from the corrective action.

14.1 Does the organization have a procedure that defines responsibility and authority for:

a) Handling and investigating nonconformance, including determining root cause of the nonconformance?

b) Taking action to mitigate impacts caused by non-conformances?

c) Initiating and completing corrective and preventive action?

Note(s)	Observations and Recommendations	Score

14.2 Has corrective or preventive action (if any) taken been appropriate to the magnitude of the problem and commensurate with the environmental impacts?

Note(s)	Observations and Recommendations	Score
If so, was the nonconformance/suggestion handled according to procedure? Has the organization implemented and recorded any changes in the documented procedures resulting from the corrective and preventive action?		

14.3 Has the organization implemented and recorded any changes in the documented procedures resulting from the corrective and preventive action?

Note(s)	Observations and Recommendations	Score
1) Have appropriate changes have been carried through the system and made in documented procedures, training, relevant work instructions/procedures, etc. 2) If no non-conformances, have there been any suggestions brought forward to improve the system? Is there a mechanism, perhaps as part of 4.4.3 Communication, whereby employees can bring forward suggestions for the EMS? Suggestions brought forward and handled appropriately in the system can be objective evidence of a procedure in place to handle corrective and preventive action. Ask to see related forms and records. Related records could include action request forms, action request logs, etc.		

14.4 Has responsibility for the following been assigned?

a) Handling and investigating nonconformance's

b) Taking action to mitigate impacts of nonconformance's

c) Initiating and completing corrective and preventive action

Note(s)	Observations and Recommendations	Score

<u>ISO 14001 Section 4.5.3 – Records</u>: The organization shall establish and maintain procedures for the identification, maintenance and disposition of environmental records. These records shall include training records and the results of audits and reviews. Environmental records shall be legible, identifiable and traceable to the activity, product or service involved. Environmental records shall be stored and maintained in such a way that they are readily retrievable and protected against damage, deterioration or loss. Their retention times shall be established and recorded. Records shall be maintained, as appropriate to the system and to the organization, to demonstrate conformance to the requirements of this standard.

4.5.3 Records

This section requires the organization to establish and maintain procedures for handling environmental records. Records are used to show that the organization is doing what procedures said would be done.

15.1 Has the organization established procedures to identify, maintain and dispose of environmental records?

Note(s)	Observations and Recommendations	Score
Training records, EMS audit records, and management review records are the minimum system records that must be kept. See that these are referenced from the Record(s) procedure.		

15.2 Has responsibility for maintenance and disposition of records been assigned?

Note(s)	Observations and Recommendations	Score
1. Are records identified, maintained, and disposed of as indicated in the procedure? Note: Sample check records to verify that records are being kept in accordance with the written retention times. 2. How frequently is it maintained/reviewed? Look to see review is occurring as stated and as often as stated. Examples of objective evidence include records of periodic. This review is commonly done by environmental staff or Management Review (4.6) but frequency of review should be specified.		

15.3 Do environmental records in the procedure include training records and the results of audits and reviews?

Note(s)	Observations and Recommendations	Score

15.4 Are environmental records:

a) Legible?

b) Identifiable?

c) Traceable to the activity, product, or service involved?

d) Readily retrievable?

e) Protected against damage, deterioration, or loss?

Note(s)	Observations and Recommendations	Score

<u>ISO 14001 Section 4.5.4 - Environmental Management System Audit</u>: The organization shall establish and maintain programs and procedures for periodic environmental management system audits to be carried out, in order to: (a) determine whether or not the environmental management system: 1) conforms to planned arrangements for environmental management including the requirements of this standard; 2) has been properly implemented and maintained; (b) provide information on the results of audits to management. The audit program, including any schedule, shall be based on the environmental importance of the activity concerned and the results of previous audits. In order to be comprehensive, the audit procedures shall cover the audit scope, frequency and methodologies, as well as the responsibilities and requirements for conducting audits and reporting results.

4.5.4 Environmental management system audits

This section requires the organization to establish and maintain procedures and programs for periodic audits of the EMS.

16.1 Has the organization established a procedure/program for periodic EMS audits?

Note(s)	Observations and Recommendations	Score

16.2 Does the audit procedure/program:

a) Determine whether or not the EMS conforms to planned arrangements for environmental management including ISO 14001?

b) Determine whether the EMS has been properly implemented and maintained?

c) Address how audit information is provided to management?

Note(s)	Observations and Recommendations	Score

16.3 Do audit procedures address the following:

a) Audit scope?

b) Audit frequency? (Note: Does the audit program and procedure provide for audit frequency and scope appropriate to the importance of the activity concerned and results of previous audits? A follow-up question may ask how the organization takes importance of the activity and results of previous audits into consideration when determining audit frequency.)

c) Audit methodologies?

d) Responsibilities and requirements for conducting and reporting audit results?

Note(s)	Observations and Recommendations	Score

<u>ISO 14001 4.6 Management Review</u>: The organization's top management shall, at intervals it determines, review the environmental management system, to ensure its continuing suitability, adequacy and effectiveness. The management review process shall ensure that the necessary information is collected to allow management to carry out this evaluation. This review shall be documented. The management review shall address the possible need for changes to policy, objectives and other elements of the EMS, in the light of environmental management system audit results, changing circumstances and the commitment to continual improvement.

4.6 Management review

This section requires the organization's top management to periodically review the EMS for suitability and effectiveness, and to make changes to the system where appropriate. This review must be documented.

17.1 Is there a procedure for top management review to ensure EMS suitability, adequacy, and effectiveness?

Note(s)	Observations and Recommendations	Score

17.2 Does the procedure address what will be reviewed?

Note(s)	Observations and Recommendations	Score

17.3 Has top management determined the frequency of the reviews?

Note(s)	Observations and Recommendations	Score

Look to see where top management determined how often it meets for management review.

17.4 Are EMS audit results reviewed during management review?

Note(s)	Observations and Recommendations	Score

17.5 Does management review address possible need for changes to the environmental policy, objectives, and other elements of the EMS?

Note(s)	Observations and Recommendations	Score

17.6 Has top management participated in the review?

Note(s)	Observations and Recommendations	Score
Verify that all procedures to be reviewed during management review are in fact reviewed at this time. Verify that possible need for changes to policy, objectives, etc., have been considered. Make sure these are documented as having been considered.		

Position/of person interviewed:

Department/work area;

1. What do you do? (What are your job responsibilities?)

Note(s)	Observations and Recommendations	Score

2. What is the environmental policy? What does policy mean to you?

Note(s)	Observations and Recommendations	Score

3. How does your work impact the environment? What do you do to reduce these impacts, to protect the environment? Listen for mention of significant impacts, objectives and targets and work instructions. How did you know to do this?

Note(s)	Observations and Recommendations	Score

Answers to this can provide objective evidence of 4.3.4 (a).

4. How do you know if you're doing your job in an environmentally-friendly way? What do you watch to make sure you don't impact the environment? Where do you look for this information? (Are there operating procedures/work instructions that relate to the environment you follow?) Do you have to record any information? Ask to see.

Note(s)	Observations and Recommendations	Score

Answers to this can provide objective evidence for
4.3.4 (b), Structure and Responsibility, and 4.4.2 Training.

5. How do you find things out? (Communication 4.4.3) How do you know if you're doing a good job environmentally?

Note(s)	Observations and Recommendations	Score

6. What environmental training have you had? When was it?

Note(s)	Observations and Recommendations	Score

7. What is the worst-case environmental scenario in this work area? What would you do if it happened? What would you do if there were an emergency? A spill? Have you had drills lately? When? (4.4.7)

Note(s)	Observations and Recommendations	Score
Ask employees who would reasonably be expected to actively respond to an emergency and check for consistency of response. Ask this to employees who would be expected to leave the situation and check for consistency of response. Objective evidence of 4.4.5 (c) Reasonable for members of emergency response/action team to have copy of plan at their workstation. Competency (4.4.2) demonstrated through question and answer acceptable.		

8. Can you provide example of something that's improved environmentally here over the last couple of years?

Note(s)	Observations and Recommendations	Score

9. What would you like to see improve environmentally here in the future?

Note(s)	Observations and Recommendations	Score

Position/of person interviewed:

Department/work area;

1. What do you do? (What are your job responsibilities?)

Note(s)	Observations and Recommendations	Score

2. What is the environmental policy? What does policy mean to you?

Note(s)	Observations and Recommendations	Score

3. How does your work impact the environment? What do you do to reduce these impacts, to protect the environment? Listen for mention of significant impacts, objectives and targets and work instructions. How did you know to do this?

Note(s)	Observations and Recommendations	Score

Answers to this can provide objective evidence of 4.3.4 (a).

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RCRA Training Module

Solid Waste and Emergency Response
(5305W)
EPA530-K-05-012

Introduction to

Hazardous Waste Identification

(40 CFR Parts 261)

United States
Environmental Protection
Agency

September 2005

HAZARDOUS WASTE IDENTIFICATION

CONTENTS

1. INTRODUCTION

"Is my waste a hazardous waste regulated under the Resource Conservation and Recovery Act (RCRA)?" This is one of the most common and basic RCRA questions and is the key to the RCRA hazardous waste program. If something is not a hazardous waste, it is not regulated under RCRA. Proper identification of a hazardous waste can be a difficult and confusing task, as the RCRA regulations establish a complex definition of the term "hazardous waste." To help make sense of what is and is not a hazardous waste, this module presents the steps involved in the process of identifying, or "characterizing," a hazardous waste.

While introducing the entire hazardous waste identification process, this module will focus on the final steps, the definition of a hazardous waste. The other steps in the process, including the definition of solid waste and the solid and hazardous waste exclusions will be discussed in other modules.

After reading this module, you will be able to explain the hazardous waste identification process and the definition of hazardous waste, and be familiar with the following concepts:

- hazardous waste listings
- hazardous waste characteristics
- the "mixture" and "derived-from" rules
- the "contained-in" policy
- the Hazardous Waste Identification Rules (HWIR).

2. REGULATORY OVERVIEW

What is a hazardous waste? In its most basic form, the answer to that question can be quite simple. A hazardous waste is a waste with a chemical composition or other properties that make it capable of causing illness, death, or some other harm to humans and other life forms when mismanaged or released into the environment. Developing a regulatory program that ensures the safe handling of such dangerous wastes, however, demands a far more precise definition of the term. EPA therefore created hazardous waste identification regulations that outline a process to determine whether any particular material is a hazardous waste for the purposes of RCRA.

2.1 HAZARDOUS WASTE IDENTIFICATION PROCESS

Proper hazardous waste identification is essential to the success of the hazardous waste management program. The RCRA regulations at 40 CFR §262.11 require that any person who produces or generates a waste must determine if that waste is hazardous. In doing so, §262.11 presents the steps in the hazardous waste identification process:

- Is the waste a "solid waste"?
- Is the waste specifically excluded from the RCRA regulations?
- Is the waste a "listed" hazardous waste?
- Does the waste exhibit a characteristic of hazardous waste?

When faced with the question of whether or not a waste is regulated as hazardous under RCRA, turn to §262.11. This regulation will remind you of the four steps in the RCRA hazardous waste identification process.

IS THE WASTE A SOLID WASTE?

Hazardous waste identification begins with an obvious point: in order for any material to be a hazardous waste, it must first be a waste. But, deciding whether an item is or is not a waste is not always easy. For example, a material (like an aluminum can) that one person discards could seem valuable to another person who recycles that material. EPA developed a set of regulations to assist in determining whether a material is a waste. RCRA uses the term "solid waste" in place of the common term "waste." Under RCRA, the term "solid waste" means any waste, whether it is a solid, semisolid, or liquid. The first section of the RCRA hazardous waste identification regulations focuses on the definition of solid waste. For this module, you need only understand in general terms the role that the definition of solid waste plays in the RCRA hazardous waste identification process. Another module, Definition of Solid Waste and Hazardous Waste Recycling, explains the definition of solid waste in greater detail.

IS THE WASTE EXCLUDED?

Only a small fraction of all RCRA solid wastes actually qualify as hazardous wastes. At first glance, one would imagine that distinguishing between hazardous and nonhazardous wastes is a

simple matter of chemical and toxicological analysis. Other factors must be considered, however, before evaluating the actual hazard that a waste's chemical composition poses. Regulation of certain wastes may be impractical, unfair, or otherwise undesirable, regardless of the hazards they pose. For instance, household waste can contain dangerous chemicals, like solvents and pesticides, but making households subject to the strict RCRA waste management regulations would create a number of practical problems. Congress and EPA exempted or excluded certain wastes, like household wastes, from the hazardous waste definition and regulations. Determining whether or not a waste is excluded or exempted from hazardous waste regulation is the second step in the RCRA hazardous waste identification process. Only after determining that a solid waste is not somehow excluded from hazardous waste regulation should the analysis proceed to evaluate the actual chemical hazard that a waste poses. The module entitled Solid and Hazardous Waste Exclusions explains which wastes are excluded from hazardous waste regulation.

IS THE WASTE A LISTED HAZARDOUS WASTE, OR DOES IT EXHIBIT A CHARACTERISTIC?

The final steps in the hazardous waste identification process determine whether a waste actually poses a sufficient chemical or physical hazard to merit regulation. These steps in the hazardous waste identification process involve evaluating the waste in light of the regulatory definition of hazardous waste. The remainder of this module explains the definition of hazardous waste in detail.

2.2 DEFINITION OF HAZARDOUS WASTE

A discussion of the definition of hazardous waste should begin with Congress' original statutory definition of the term. RCRA §1004(5) defines hazardous waste as:

> A solid waste, or combination of solid waste, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

This broad statutory definition provides a general indication of which wastes Congress intended to regulate as hazardous, but it obviously does not provide the clear distinctions necessary for industrial waste handlers to determine whether their wastes pose a sufficient threat to warrant regulation or not. Congress instructed EPA to develop more specific criteria for defining hazardous waste. There are therefore two definitions of hazardous waste under the RCRA program: a statutory definition and a regulatory definition. The statutory definition cited above is seldom used today. It served primarily as a general guideline for EPA to follow in developing the regulatory definition of hazardous waste. The regulatory definition is an essential element of the current RCRA program. It precisely identifies which wastes are subject to RCRA waste management regulations.

Congress asked EPA to fulfill the task of developing a regulatory definition of hazardous waste by using two different mechanisms: by listing certain specific wastes as hazardous and by identifying characteristics which, when present in a waste, make it hazardous. Following its statutory mandate, EPA developed a regulatory definition of hazardous waste that incorporates both listings and characteristics.

HAZARDOUS WASTE LISTINGS

A hazardous waste listing is a narrative description of a specific type of waste that EPA considers dangerous enough to warrant regulation. Hazardous waste listings describe wastes from various industrial processes, wastes from specific sectors of industry, or wastes in the form of specific chemical formulations. Before developing a hazardous waste listing, EPA thoroughly studies a particular wastestream and the threat it can pose to human health and the environment. If the waste poses enough of a threat, EPA includes a precise description of that waste on one of the hazardous waste lists in the regulations. Thereafter, any waste fitting that narrative listing description is considered hazardous, regardless of its chemical composition or any other potential variable. For example, one of the current hazardous waste listings reads as: "API separator sludge from the petroleum refining industry." An API separator is a device commonly used by the petroleum refining industry to separate contaminants from refinery wastewaters. After studying the petroleum refining industry and typical sludges from API separators, EPA decided these sludges were dangerous enough to warrant regulation as hazardous waste under all circumstances. The listing therefore designates all petroleum refinery API separator sludges as hazardous. Chemical composition or other factors about a specific sample of API separator sludge are not relevant to its status as hazardous waste under the RCRA program.

Using listings to define hazardous wastes presents certain advantages and disadvantages. One advantage is that listings make the hazardous waste identification process easy for industrial waste handlers. Only knowledge of a waste's origin is needed to determine if it is listed; laboratory analysis is unnecessary. By comparing any waste to narrative listing descriptions, one can easily determine whether or not the waste is hazardous. EPA's use of listings also presents certain disadvantages. For example, listing a waste as hazardous demands extensive study of that waste by EPA. EPA lacks the resources to investigate the countless types of chemical wastes produced in the United States – the hazardous waste listings simply cannot address all dangerous wastes. Another disadvantage of the hazardous waste listings is their lack of flexibility. Listings designate a waste as hazardous if it falls within a particular category or class. The actual composition of the waste is not a consideration as long as the waste matches the appropriate listing description. For instance, some API separator sludges from petroleum refining might contain relatively few hazardous constituents and pose a negligible risk to human health and the environment. Such sludges are still regulated as hazardous, however, because the listing for this wastestream does not consider the potential variations in waste composition. Thus, the hazardous waste listings can unnecessarily regulate some wastes that do not pose a significant health threat. It is also possible for industries to substantially change their processes so that wastes would no longer meet a listing description in spite of the presence of hazardous constituents. The hazardous waste characteristics provide an important complement to listings

by addressing most of the shortcomings of the listing methodology of hazardous waste identification.

HAZARDOUS WASTE CHARACTERISTICS

A hazardous waste characteristic is a property which, when present in a waste, indicates that the waste poses a sufficient threat to merit regulation as hazardous. When defining hazardous waste characteristics, EPA does not study particular wastestreams from specific industries. Instead, EPA asks the question, "what properties or qualities can a waste have which cause that waste to be dangerous?" For example, EPA found that ignitability, or the tendency for a waste to easily catch fire and burn, is a dangerous property. Thus, ignitability is one of the hazardous waste characteristics and a waste displaying that property is regulated as hazardous, regardless of whether the waste is listed. When defining hazardous waste characteristics, EPA identifies, where practicable, analytical tests capable of detecting or demonstrating the presence of the characteristic. For instance, EPA regulations reference a laboratory flash point test to be used when deciding if a liquid waste is ignitable. Whether or not a waste displays a hazardous characteristic generally depends on how it fares in one of the characteristics tests. Therefore, the chemical makeup or other factors about the composition of a particular waste typically determine whether or not it tests as hazardous for a characteristic.

Using characteristics to define hazardous wastes presents certain advantages over designating hazardous wastes by listings. One advantage is that hazardous characteristics and the tests used to evaluate their presence have broad applicability. Once EPA has defined a characteristic and selected a test for use in identifying it, waste handlers can evaluate any wastestream to see if it is classified as a hazardous waste. Furthermore, use of characteristics can be a more equitable way of designating wastes as hazardous. Instead of categorizing an entire group of wastes as hazardous, characteristics allow a waste handler to evaluate each waste sample on its own merits and classify it according to the actual danger it poses. Aware of these advantages, EPA originally planned to use characteristics as the primary means of identifying hazardous waste. EPA hoped to define and select test methods for identifying all hazardous characteristics, including organic toxicity, mutagenicity (the tendency to cause mutations), teratogenicity (the tendency to cause defects in offspring), bioaccumulation potential, and phytotoxicity (toxicity to plants). EPA encountered problems, however, when trying to develop regulatory definitions of these properties. One primary problem was that no straightforward testing protocols were available for use in determining if a waste possessed any of these characteristics. For example, deciding if a particular wastestream poses an unacceptable cancer risk demands extensive laboratory experimentation. Requiring such analysis on a routine basis from industrial waste handlers would be impractical. Therefore, EPA developed a hazardous waste definition that relies on both listings and characteristics to define hazardous wastes.

2.3 LISTED HAZARDOUS WASTES

EPA has studied and listed as hazardous hundreds of specific industrial wastestreams. These wastes are described or listed on four different lists that are found in the regulations at Part 261, Subpart D. These four lists are:

- The F list — The F list designates particular solid wastes from certain common industrial or manufacturing processes as hazardous. Because the processes producing these wastes can occur in different sectors of industry, the F list wastes are known as wastes from nonspecific sources. The F list is codified in the regulations at §261.31.

- The K list — The K list designates particular solid wastes from certain specific industries as hazardous. K list wastes are known as wastes from specific sources. The K list is found at §261.32.

- The P list and the U list — These two lists are similar in that both list pure or commercial grade formulations of certain specific unused chemicals as hazardous. Both the P list and U list are codified in §261.33.

These four lists each designate anywhere from 30 to a few hundred wastestreams as hazardous. Each waste on the lists is assigned a waste code consisting of the letter associated with the list followed by three numbers. For example, the wastes on the F list are assigned the waste codes F001, F002, and so on. These waste codes are an important part of the RCRA regulatory system. Assigning the correct waste code to a waste has important implications for the management standards that apply to the waste.

LISTING CRITERIA

Before listing any waste as hazardous, the Agency developed a set of criteria to use as a guide when determining whether or not a waste should be listed. These listing criteria provide a consistent frame of reference when EPA considers listing a wastestream. Remember that EPA only uses these criteria when evaluating whether to list a waste; the listing criteria are not used by waste handlers, who refer to the actual hazardous waste lists for hazardous waste identification purposes. There are four different criteria upon which EPA may base its determination to list a waste as hazardous. These criteria are codified in Part 261, Subpart B. Note that these four criteria do not directly correspond to the four different lists of hazardous waste. The four criteria EPA may use to list a waste are:

- The waste typically contains harmful chemicals, and other factors indicate that it could pose a threat to human health and the environment in the absence of special regulation. Such wastes are known as toxic listed wastes.

- The waste contains such dangerous chemicals that it could pose a threat to human health and the environment even when properly managed. Such wastes are known as acutely hazardous wastes.

- The waste typically exhibits one of the four characteristics of hazardous waste described in the hazardous waste identification regulations (ignitability, corrosivity, reactivity, or toxicity).

- When EPA has to cause to believe for some other reason, the waste typically fits within the statutory definition of hazardous waste developed by Congress.

EPA may list a waste as hazardous for any and all of the above reasons. The majority of listed wastes fall into the toxic waste category. To decide if a waste should be a toxic listed waste, EPA first determines whether it typically contains harmful chemical constituents. Appendix VIII of Part 261 contains a list of chemical compounds or elements which scientific studies show to have toxic, carcinogenic, mutagenic, or teratogenic effects on humans or other life forms. If a waste contains chemical constituents found on the Appendix VIII list, EPA then evaluates 11 other factors to determine if the wastestream is likely to pose a threat in the absence of special restrictions on its handling. These additional considerations include a risk assessment and study of past cases of damage caused by the waste.

Acutely hazardous wastes are the second most common type of listed waste. EPA designates a waste as acutely hazardous if it contains Appendix VIII constituents that scientific studies show to be fatal to humans or animals in low doses. In a few cases, acutely hazardous wastes contain no Appendix VIII constituents, but are extremely dangerous for another reason. An example is the listed waste P081, which designates unused discarded formulations of nitroglycerine as acutely hazardous. Although nitroglycerine is not an Appendix VIII hazardous constituent, wastes containing unused nitroglycerine are so unstable that they pose an acute hazard. The criteria for designating a waste as acutely hazardous require only that EPA considers the typical chemical makeup of the wastestream. EPA is not required to study other factors, such as relative risk and evidence of harm, when listing a waste as acutely hazardous.

To indicate its reason for listing a waste, EPA assigns a hazard code to each waste listed on the F, K, P, and U lists. These hazard codes are listed below. The last four hazard codes apply to wastes that have been listed because they typically exhibit one of the four regulatory characteristics of hazardous waste. You will learn more about the four characteristics of hazardous waste. The hazard codes indicating the basis for listing a waste are:

Toxic Waste	(T)
Acute Hazardous Waste	(H)
Ignitable Waste	(I)
Corrosive Waste	(C)
Reactive Waste	(R)
Toxicity Characteristic Waste	(E)

The hazard codes assigned to listed wastes affect the regulations that apply to handling the waste. For instance, acute hazardous wastes accompanied by the hazard code (H) are subject to stricter management standards than most other wastes.

THE F LIST: WASTES FROM NONSPECIFIC SOURCES

The F list designates as hazardous particular wastestreams from certain common industrial or manufacturing processes. F list wastes usually consist of chemicals that have been used for their intended purpose in an industrial process. That is why F list wastes are known as

"manufacturing process wastes." The F list wastes can be divided into seven groups, depending on the type of manufacturing or industrial operation that creates them. The seven categories of F-listed wastes are:

- spent solvent wastes (F001 - F005)
- wastes from electroplating and other metal finishing operations (F006 - F012, F019)
- dioxin-bearing wastes (F020 - F023 and F026 - F028)
- wastes from the production of certain chlorinated aliphatic hydrocarbons (F024, F025)
- wastes from wood preserving (F032, F034, and F035)
- petroleum refinery wastewater treatment sludges (F037 and F038)
- multisource leachate (F039).

Spent Solvent Wastes

Waste codes F001 - F005 apply to wastestreams from the use of certain common organic solvents. Solvents are chemicals with many uses, although they are most often used in degreasing or cleaning. The solvents covered by the F listings are commonly used in industries ranging from mechanical repair to dry cleaning to electronics manufacturing. EPA decided that only certain solvents used in certain ways produce wastestreams that warrant a hazardous waste listing. Therefore, a number of key factors must be evaluated in order to determine whether the F001 - F005 waste codes apply to a particular waste solvent. First, one or more of the 31 specific organic solvents designated in the F001 - F005 listing description must have been used in the operation that created the waste. Second, the listed solvent must have been used in a particular manner – it must have been used for its "solvent properties," as EPA defines that expression. Finally, EPA decided that only a wastestream created through use of concentrated solvents should be listed. Thus, the concentration of the solvent formulation or product before its use in the process that created the waste is also a factor in determining the applicability of the F001 - F005 listing.

The F001 - F005 spent solvent listings provide a good illustration of a principle common to all listed hazardous wastes. To determine whether a waste qualifies as listed, knowledge of the process that created the waste is essential, while information about the waste's chemical composition is often irrelevant. For example, the F005 listing description can allow two different wastes with identical chemical contents to be regulated differently because of subtle differences in the processes that created the wastes. A waste made up of toluene and paint is F005 if the toluene has been used to clean the paint from brushes or some other surface. A waste with the same chemical composition is not F005 if the toluene has been used as an ingredient (such as a thinner) in the paint. EPA considers use as a cleaner to be "use as a solvent;" use as an ingredient does not qualify as solvent use. As you can see, knowledge of the process that created a waste is the key in evaluating whether a waste can be a hazardous spent solvent or other listed hazardous waste.

Wastes from Electroplating and Other Metal-Finishing Operations

The listed hazardous wastes F006 - F012 and F019 are wastes commonly produced during electroplating and other metal finishing operations. Diverse industries use electroplating and other methods to change the surface of metal objects in order to enhance the appearance of the objects, make them more resistant to corrosion, or impart some other desirable property to them. Industries involved in plating and metal finishing range from jewelry manufacture to automobile production. A variety of techniques can be used to amend a metal's surface. For example, electroplating uses electricity to deposit a layer of a decorative or protective metal on the surface of another metal object. Chemical conversion coating also amends the surface of a metal, but does so by chemically converting (without use of electricity) a layer of the original base metal into a protective coating. Because each of these processes produces different types of wastes, EPA only designated wastes from certain metal-finishing operations as hazardous. The first step in determining whether one of the F006-F012 or F019 listings applies to a waste is identifying the type of metal finishing process involved in creating the waste:

- F006 - F009 listings only apply to wastes from electroplating operations
- F010 - F012 listings only apply to wastes from metal heat treating operations
- the F019 listing only applies to wastes from the chemical conversion coating of aluminum.

Dioxin-Bearing Wastes

The listed wastes F020 - F023 and F026 - F028 are commonly known as the "dioxin-bearing wastes." These listings describe a number of wastestreams that EPA believes are likely to contain dioxins, which are considered to be among the most dangerous known chemical compounds. The dioxin listings apply primarily to manufacturing process wastes from the production of specific pesticides or specific chemicals used in the production of pesticides. The F027 listing deserves special notice because it does not apply to used manufacturing wastes. It applies only to certain unused pesticide formulations. F027 is in fact the only listing on the F list or K list that describes an unused chemical rather than an industrial wastestream consisting of chemicals that have served their intended purpose. With the exception of F028, all of the dioxin-bearing wastes are considered acute hazardous wastes and are designated with the hazard code (H). These wastes are therefore subject to stricter management standards than other hazardous wastes.

Wastes from the Production of Certain Chlorinated Aliphatic Hydrocarbons

The F024 and F025 listings designate as hazardous certain wastestreams produced in the manufacture of chlorinated aliphatic hydrocarbons. These listings stand out on the F list (the list of wastes from nonspecific sources) because they focus on wastes from a very narrow industrial sector. Many other wastestreams from the manufacture of organic chemicals are listed on the K list, the list of wastes from specific sources, including two waste codes for chlorinated aliphatic wastes, K174 and K175.

Wood Preserving Wastes

The F032, F034, and F035 listings apply to certain wastes from wood preserving operations. Many types of wood used for construction or other non-fuel applications is chemically treated to slow the deterioration caused by decay and insects. Such chemical treatment is commonly used in telephone poles, railroad ties, and other wood products prepared to withstand the rigors of outdoor use. Wood preservation typically involves pressure treating the lumber with pentachlorophenol, creosote, or preservatives containing arsenic or chromium. (It should be noted that after December 31, 2003, many wood treaters will not be using arsenic or chromium based inorganic preservatives.) The wood preserving process creates a number of common wastestreams containing these chemicals. For example, once wood has been treated with a preservative excess preservative drips from the lumber. The F032, F034, and F035 listings designate this preservative drippage as listed hazardous waste. These listings also apply to a variety of other residues from wood preserving. Whether the F032, F034, or F035 listings apply to a particular wood preserving waste depends entirely on the type of preservative used at the facility. Waste generated from wood preserving processes using pentachlorophenol is F032, waste from the use of creosote is F034, and waste from treating wood with arsenic or chromium is F035. The K list also includes a waste code, K001, which applies to bottom sediment sludge from treating wastewaters associated with processes using pentachlorophenol and/or creosote.

Petroleum Refinery Wastewater Treatment Sludges

The F037 and F038 listings apply to specific wastestreams from petroleum refineries. The petroleum refining process typically creates large quantities of contaminated wastewater. Before this wastewater can be discharged to a river or sewer, it must be treated to remove oil, solid material, and chemical pollutants. Gravity provides a simple way of separating these pollutants from refinery wastewaters. Over time, solids and heavier pollutants precipitate from wastewaters to form a sludge. Other less dense pollutants accumulate on the surface of wastewaters, forming a material known as float. These gravitational separation processes can be encouraged through chemical or mechanical means. The F037 listing applies to the sludges and float created by gravitational treatment of petroleum refinery wastewaters. The F038 listing applies to sludges and float created during the chemical or physical treatment of refinery wastewaters. The K list also includes waste codes for certain petroleum wastestreams generated by the petroleum refining industry. These waste codes are K048 through K052 and K169 through K172.

Multisource Leachate

The F039 listing applies to multisource leachate, the liquid material that accumulates at the bottom of a hazardous waste landfill. Understanding the natural phenomenon known as leaching is essential to understanding a number of key RCRA regulations. Leaching occurs when liquids such as rainwater filter through soil or buried materials, such as wastes placed in a landfill. When this liquid comes in contact with buried wastes, it leaches or draws chemicals out of those wastes. This liquid (called leachate) can then carry the leached chemical contaminants further into the ground, eventually depositing them elsewhere in the subsurface or in groundwater. The leachate that percolates through landfills, particularly hazardous waste landfills, usually contains high concentrations of chemicals, and is often collected to minimize the potential that it may enter the subsurface environment and contaminate soil or groundwater. This leachate that

percolates through hazardous waste landfills and other buried hazardous waste is designated as F039.

THE K LIST: WASTES FROM SPECIFIC SOURCES

The K list of hazardous wastes designates particular wastes from specific sectors of industry and manufacturing as hazardous. The K list wastes are therefore known as wastes from specific sources. Like F list wastes, K list wastes are manufacturing process wastes. They contain chemicals that have been used for their intended purpose. To determine whether a waste qualifies as K-listed, two primary questions must be answered. First, is the facility that created the waste within one of the industrial or manufacturing categories on the K list? Second, does the waste match one of the specific K list waste descriptions? The 13 industries that can generate K list wastes are:

- wood preservation
- inorganic pigment manufacturing
- organic chemicals manufacturing
- inorganic chemicals manufacturing
- pesticides manufacturing
- explosives manufacturing
- petroleum refining
- iron and steel production
- primary aluminum production
- secondary lead processing
- veterinary pharmaceuticals manufacturing
- ink formulation
- coking (processing of coal to produce coke, a material used in iron and steel production).

Remember that not all wastes from these 13 industries are hazardous, only those specifically described in the detailed K list descriptions.

Previously, the K list included waste codes for 17 different industries. However, EPA revoked the K waste codes applicable to the wastestreams in the primary copper, primary lead, primary zinc, and ferroalloys industries (K064, K065, K066, K090, and K091) (63 FR 28556, 28579; May 26, 1998). Currently, there are no K waste codes applicable to these four industries.

In general, the K listings target much more specific wastestreams than the F listings. For example, EPA added a number of listings to the petroleum refining category of the K list. EPA estimates that one hundred facilities nationwide produce wastestreams covered by these new K listings. In contrast, F-listed spent solvent wastes are commonly generated in thousands of different plants and facilities. You may also notice that industries generating K-listed wastes, such as the wood preserving and petroleum refining industries, can also generate F-listed wastes. Typically, K listings describe more specific wastestreams than F listings applicable to the same industry. For example, K051 and K048 designate as hazardous two very specific types of petroleum refinery wastewater treatment residues: wastewater treatment sludges created in API separators and wastewater treatment float created using dissolved air flotation (DAF) pollution

control devices. The F037 and F038 listings complement these two K listings by designating as hazardous all other types of petroleum refinery wastewater treatment sludges and floats. These petroleum refinery listings illustrate that the K listings are typically more specific than the F listings. They also illustrate that the two lists are in many ways very similar.

THE P AND U LISTS: DISCARDED COMMERCIAL CHEMICAL PRODUCTS

The P and U lists designate as hazardous pure or commercial grade formulations of certain unused chemicals. As you will see, the P and U listings are quite different from the F and K listings. For a waste to qualify as P- or U-listed, a waste must meet the following three criteria:

- the waste must contain one of the chemicals listed on the P or U list
- the chemical in the waste must be unused
- the chemical in the waste must be in the form of a "commercial chemical product," as EPA defines that term.

The following paragraphs explore these three criteria in detail and examine EPA's rationale in creating the P and U lists.

You have already learned that hazardous waste listings are narrative descriptions of specific wastestreams and that a waste's actual chemical composition is generally irrelevant to whether a listing applies to it. At first glance, the P and U listings seem inconsistent with these principles. Each P and U listing consists only of the chemical name of a compound known to be toxic or otherwise dangerous; no description is included. EPA adopted this format because the same narrative description applies to all P and U list wastes. Instead of appearing next to each one of the hundreds of P and U list waste codes, this description is found in the regulatory text that introduces the two lists.

The generic P and U list waste description involves two key factors. First, a P or U listing applies only if one of the listed chemicals is discarded unused. In other words, the P and U lists do not apply to manufacturing process wastes, as do the F and K lists. The P and U listings apply to unused chemicals that become wastes. Unused chemicals become wastes for a number of reasons. For example, some unused chemicals are spilled by accident. Others are intentionally discarded because they are off-specification and cannot serve the purpose for which they were originally produced.

The second key factor governing the applicability of the P or U listings is that the listed chemical must be discarded in the form of a "commercial chemical product." EPA uses the phrase commercial chemical product to describe a chemical that is in pure form, that is in commercial grade form, or that is the sole active ingredient in a chemical formulation. The pure form of a chemical is a formulation consisting of 100 percent of that chemical. The commercial grade form of a chemical is a formulation in which the chemical is almost 100 percent pure, but contains minor impurities. A chemical is the sole active ingredient in a formulation if that chemical is the only ingredient serving the function of the formulation. For instance, a pesticide made for killing insects may contain a poison such as heptachlor as well as various solvent ingredients which act as carriers or lend other desirable properties to the poison. Although all of

these chemicals may be capable of killing insects, only the heptachlor serves the primary purpose of the insecticide product. The other chemicals involved are present for other reasons, not because they are poisonous. Therefore, heptachlor is the sole active ingredient in such a formulation even though it may be present in low concentrations.

As you can see, the P and U listings apply only to a very narrow category of wastes. For example, an unused pesticide consisting of pure heptachlor is listed waste P059 when discarded. An unused pesticide consisting of pure toxaphene is listed waste P123 when discarded. An unused pesticide made up of 50 percent heptachlor and 50 percent toxaphene as active ingredients, while being just as deadly as the first two formulations, is not a listed waste when discarded. That is because neither compound is discarded in the form of a commercial chemical product. Why did EPA choose such specific criteria for designating P- or U-listed chemicals as hazardous? When first developing the definition of hazardous waste, EPA was not able to identify with confidence all the different factors that can cause a waste containing a known toxic chemical to be dangerous. It was obvious, however, those wastes consisting of pure, unadulterated forms of certain chemicals were worthy of regulation. EPA used the P and U lists to designate hazardous wastes consisting of pure or highly concentrated forms of known toxic chemicals. As you will see in the following sections of the module, wastes that remain unregulated by listings may still fall under protective hazardous waste regulation due to the four characteristics of hazardous waste.

2.4 CHARACTERISTIC HAZARDOUS WASTES

A hazardous waste characteristic is a property that indicates that a waste poses a sufficient threat to deserve regulation as hazardous. EPA tried to identify characteristics which, when present in a waste, can cause death or illness in humans or ecological damage. EPA also decided that the presence of any characteristic of hazardous waste should be detectable by using a standardized test method or by applying general knowledge of the waste's properties. EPA believed that unless generators were provided with widely available and uncomplicated test methods for determining whether their wastes exhibited hazardous characteristics, this system of identifying hazardous wastes would be unfair and impractical. Given these criteria, EPA only finalized four hazardous waste characteristics. These characteristics are a necessary supplement to the hazardous waste listings. They provide a screening mechanism that waste handlers must apply to all wastes from all industries. In this sense, the characteristics provide a more complete and inclusive means of identifying hazardous wastes than do the hazardous waste listings. The four characteristics of hazardous waste are:

- ignitability
- corrosivity
- reactivity
- toxicity.

The regulations explaining these characteristics and the test methods to be used in detecting their presence are found in Part 261, Subpart C. Note that although waste handlers can use the test methods referenced in Subpart C to determine whether a waste displays characteristics, they are not required to do so. In other words, any handler of industrial waste may apply knowledge of

the waste's properties to determine if it exhibits a characteristic, instead of sending the waste for expensive laboratory testing. As with listed wastes, characteristic wastes are assigned waste codes. Ignitable, corrosive, and reactive wastes carry the waste codes D001, D002, and D003, respectively. Wastes displaying the characteristic of toxicity can carry any of the waste codes D004 through D043.

IGNITABILITY

Ignitable wastes are wastes that can readily catch fire and sustain combustion. Many paints, cleaners, and other industrial wastes pose such a fire hazard. Most ignitable wastes are liquid in physical form. EPA selected a flash point test as the method for determining whether a liquid waste is combustible enough to deserve regulation as hazardous. The flash point test determines the lowest temperature at which a chemical ignites when exposed to flame. Many wastes in solid or nonliquid physical form (e.g., wood, paper) can also readily catch fire and sustain combustion, but EPA did not intend to regulate most of these nonliquid materials as ignitable wastes. A nonliquid waste is only hazardous due to ignitability if it can spontaneously catch fire under normal handling conditions and can burn so vigorously that it creates a hazard. Certain compressed gases and chemicals called oxidizers can also be ignitable. Ignitable wastes carry the waste code D001 and are among the most common hazardous wastes. The regulations describing the characteristic of ignitability are codified at §261.21.

CORROSIVITY

Corrosive wastes are acidic or alkaline (basic) wastes which can readily corrode or dissolve flesh, metal, or other materials. They are also among the most common hazardous wastestreams. Waste sulfuric acid from automotive batteries is an example of a corrosive waste. EPA uses two criteria to identify corrosive hazardous wastes. The first is a pH test. Aqueous wastes with a pH greater than or equal to 12.5, or less than or equal to 2 are corrosive under EPA's rules. A waste may also be corrosive if it has the ability to corrode steel in a specific EPA-approved test protocol. Corrosive wastes carry the waste code D002. The regulations describing the corrosivity characteristic are found at §261.22.

REACTIVITY

A reactive waste is one that readily explodes or undergoes violent reactions. Common examples are discarded munitions or explosives. In many cases, there is no reliable test method to evaluate a waste's potential to explode or react violently under common handling conditions. Therefore, EPA uses narrative criteria to define most reactive wastes and allows waste handlers to use their best judgment in determining if a waste is sufficiently reactive to be regulated. This is possible because reactive hazardous wastes are relatively uncommon and the dangers they pose are well known to the few waste handlers who deal with them. A waste is reactive if it meets any of the following criteria:

- it can explode or violently react when exposed to water, when heated, or under normal handling conditions

- it can create toxic fumes or gases when exposed to water or under normal handling conditions

- it meets the criteria for classification as an explosive under Department of Transportation rules

- it generates toxic levels of sulfide or cyanide gas when exposed to a pH range of 2 through 12.5.

Wastes exhibiting the characteristic of reactivity are assigned the waste code D003. The reactivity characteristic is described in the regulations at §261.23.

TOXICITY CHARACTERISTIC

The leaching of toxic compounds or elements into groundwater drinking supplies from wastes disposed of in landfills is one of the most common ways the general population can be exposed to the chemicals found in industrial wastes. EPA developed a characteristic designed to identify wastes likely to leach dangerous concentrations of certain known toxic chemicals into groundwater. In order to predict whether any particular waste is likely to leach chemicals into groundwater in the absence of special restrictions on its handling, EPA first designed a lab procedure that replicates the leaching process and other effects that occur when wastes are buried in a typical municipal landfill. This lab procedure is known as the Toxicity Characteristic Leaching Procedure (TCLP). Using the TCLP on a waste sample creates a liquid leachate that is similar to the liquid EPA would expect to find in the ground near a landfill containing the same waste. Once the leachate is created in the lab, a waste handler must determine whether it contains any of 39 different toxic chemicals above specified regulatory levels. If the leachate sample contains a sufficient concentration of one of the specified chemicals, the waste exhibits the toxicity characteristic (TC). EPA used groundwater modeling studies and toxicity data for a number of common toxic compounds and elements to set these threshold concentration levels. Much of the toxicity data were originally developed under the Safe Drinking Water Act.

However, there is one exception to using the TCLP to identify a waste as hazardous. The D.C. Circuit Court, in *Association of Battery Recyclers vs. EPA*, vacated the use of the TCLP to determine whether manufactured gas plant (MGP) wastes exhibit the characteristic of toxicity. As previously stated, the TCLP replicates the leaching process in municipal landfills. The court found that EPA did not produce sufficient evidence that co-disposal of MGP wastes from remediation sites with municipal solid waste (MSW) has happened or is likely to happen. On March 13, 2002, in response to the court vacatur, EPA codified language exempting MGP waste from the toxicity characteristic regulation (67 FR 11251).

To recap, determining whether a waste exhibits the toxicity characteristic involves two principal steps: (1) creating a leachate sample using the TCLP; and (2) evaluating the concentration of 39 chemicals in that sample against the regulatory levels listed below in Table 1. If a waste exhibits the TC, it carries the waste code associated with the compound or element that exceeded the regulatory level. The following table presents the toxicity characteristic waste codes, regulated constituents, and regulatory levels. This table and the regulations describing the characteristic of toxicity are

codified at §261.24.

Table 1
TOXICITY CHARACTERISTIC CONSTITUENTS AND REGULATORY LEVELS

Waste Code	Contaminants	Concentration
D004	Arsenic	5.0
D005	Barium	100.0
D018	Benzene	0.5
D006	Cadmium	1.0
D019	Carbon tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium	5.0
D023	o-Cresol*	200.0
D024	m-Cresol*	200.0
D025	p-Cresol*	200.0
D026	Total Cresols*	200.0
D016	2,4-D	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D012	Endrin	0.02
D031	Heptachlor (and its epoxide)	0.008
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3.0
D008	Lead	5.0
D013	Lindane	0.4
D009	Mercury	0.2
D014	Methoxychlor	10.0
D035	Methyl ethyl ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0
D010	Selenium	1.0
D011	Silver	5.0
D039	Tetrachloroethylene	0.7
D015	Toxaphene	0.5
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D017	2,4,5-TP (Silvex)	1.0
D043	Vinyl chloride	0.2

*If o-, m-, and p-cresols cannot be individually measured, the regulatory level for total cresols is used.

2.5 WASTES LISTED SOLELY FOR EXHIBITING THE CHARACTERISTIC OF IGNITABILITY, CORROSIVITY, AND/OR REACTIVITY

Hazardous wastes listed solely for exhibiting the characteristic of ignitability, corrosivity, and/or reactivity are not regulated the same way that other listed hazardous wastes are regulated under RCRA. When wastes are generated that meet a listing description for one of the 29 wastes listed only for exhibiting the characteristic of ignitability, corrosivity, and/or reactivity, the waste is not hazardous if it does not exhibit a characteristic (66 FR 27266, 27283; May 16, 2001). This concept is consistent with the mixture and derived-from rules, which will be discussed in detail later in this module. For example, F003 is listed for the characteristic of ignitability. If a waste is generated and meets the listing description for F003 but does not exhibit the characteristic of ignitability, it is not regulated as a hazardous waste. However, such wastes are still subject to the land disposal restrictions unless they do not exhibit a characteristic at the point of generation.

2.6 THE MIXTURE AND DERIVED-FROM RULES

So far, this module has introduced the fundamentals of the hazardous waste identification process and an overview of the hazardous waste listings and characteristics. You should now be able to explain in general terms which solid wastes are hazardous wastes. Now we analyze a new question: "When do these hazardous wastes cease being regulated as hazardous wastes?" The regulations governing this issue are commonly known as the mixture and derived-from rules.

BACKGROUND

When EPA first developed the RCRA regulations and the definition of hazardous waste in the late 1970s, the Agency focused on establishing the listings and characteristics, criteria allowing industry to identify which wastes deserved regulation as hazardous wastes. Commenters on EPA's original proposed regulations brought up other key questions about the hazardous waste identification process. For example, these commenters asked, "once a waste is identified as hazardous, what happens if that waste changes in some way? If the hazardous waste is changed, either by mixing it with other wastes or by treating it to modify its chemical composition, should it still be regulated as hazardous?" Faced with a short time frame for answering this difficult question, EPA developed a fairly simple and strict answer and presented it in the mixture and derived-from rules.

LISTED HAZARDOUS WASTES

The mixture and derived-from rules operate differently for listed waste and characteristic wastes. The mixture rule for listed wastes states that a mixture made up of any amount of a nonhazardous solid waste and any amount of a listed hazardous waste is considered a listed hazardous waste. In other words, if a small vial of listed waste is mixed with a large quantity of nonhazardous waste, the resulting mixture bears the same waste code and regulatory status as the original listed component of the mixture. This principle applies regardless of the actual health

threat posed by the waste mixture or the mixture's chemical composition. The derived-from rule governs the regulatory status of materials that are created by treating or changing a hazardous waste in some way. For example, ash created by burning a hazardous waste is considered "derived-from" that hazardous waste. The derived-from rule for listed wastes states that any material derived from a listed hazardous waste is also a listed hazardous waste. Thus, ash produced by burning a listed hazardous waste bears that same waste code and regulatory status as the original listed waste, regardless of the ash's actual properties.

The net effect of the mixture and derived-from rules for listed wastes can be summarized as follows: once a waste matches a listing description, it is forever a listed hazardous waste, regardless of how it is mixed, treated, or otherwise changed. Furthermore, any material that comes in contact with the listed waste will also be considered listed, regardless of its chemical composition.

Although the regulations do provide a few exceptions to the mixture and derived-from rules, most listed hazardous wastes are subject to the strict principles outlined above. Why did EPA create such a rigid system? To understand the logic behind the mixture and derived-from rules, one must consider the circumstances under which EPA developed them. If EPA relied solely on the narrative listing descriptions to govern when a waste ceased being hazardous, industry might easily circumvent RCRA's protective regulation. For example, a waste handler could simply mix different wastes and claim that they no longer exactly matched the applicable hazardous waste listing descriptions. These wastes would no longer be regulated by RCRA, even though the chemicals they contained would continue to pose the same threats to human health and the environment. EPA was not able to determine what sort of treatment or concentrations of chemical constituents indicated that a waste no longer deserved regulation. EPA therefore adopted the simple, conservative approach of the mixture and derived-from rules, while admitting that these rules might make some waste mixtures and treatment residues subject to unnecessary regulation. Adopting the mixture and derived-from rules also presented certain advantages. For instance, the mixture rule gives waste handlers a clear incentive to keep their listed hazardous wastes segregated from other nonhazardous or less dangerous wastestreams. The greater the volume of hazardous waste, the more expensive it is to store, treat and dispose.

CHARACTERISTIC WASTES

As mentioned previously, the mixture and derived-from rules apply differently to listed and characteristic wastes. A mixture involving characteristic wastes is hazardous only if the mixture itself exhibits a characteristic. Similarly, treatment residues and materials derived from characteristic wastes are hazardous only if they themselves exhibit a characteristic. Unlike listed hazardous wastes, characteristic wastes are hazardous because they possess one of four unique and measurable properties. EPA decided that once a characteristic waste no longer exhibits one of these four dangerous properties, it no longer deserves regulation as hazardous. Thus, a characteristic waste can be made nonhazardous by treating it to remove its hazardous property; however, EPA places certain restrictions on the manner in which a waste can be treated. You will learn more about these restrictions in the module entitled Land Disposal Restrictions. Handlers who render characteristic wastes nonhazardous must consider these restrictions when treating wastes to remove their hazardous properties.

WASTE LISTED SOLELY FOR EXHIBITING THE CHARACTERISTIC OF IGNITABILITY, CORROSIVITY, AND/OR REACTIVITY

All wastes listed solely for exhibiting the characteristic of ignitability, corrosivity and/or reactivity characteristic (including mixtures, derived-from, and as-generated wastes) are not regulated as hazardous wastes once they no longer exhibit a characteristic (66 FR 27266, 27268; May 16, 2001). EPA can list a waste as hazardous if that waste typically exhibits one or more of the four hazardous waste characteristics. If a hazardous waste listed only for the characteristics of ignitability, corrosivity and/or reactivity is mixed with a solid waste, the original listing does not carry through to the resulting mixture if that mixture does not exhibit any hazardous waste characteristics. For example, EPA listed the F003 spent solvents as hazardous because these wastes typically display the ignitability characteristic. If F003 waste is treated by mixing it with another waste, and the resulting mixture does not exhibit a characteristic, the F003 listing no longer applies. (Be aware, however, that for the land disposal restrictions, the Agency places certain controls on how hazardous wastes can be treated or mixed with other wastes. Any hazardous waste mixing must be consistent with these rules.)

If a waste derived from the treatment, storage, or disposal of a hazardous waste listed for the characteristics of ignitability, corrosivity, and/or reactivity, no longer exhibits one of those characteristics, it is not a hazardous waste (§261.3(g)(2)(ii)). For example, if a sludge is generated from the treatment of F003, and that sludge does not exhibit the characteristic of ignitability, corrosivity, or reactivity, the F003 listing will not apply to the sludge.

MIXTURE RULE EXEMPTIONS

There are a few situations in which EPA does not require strict application of the mixture and derived-from rules. EPA determined that certain mixtures involving listed wastes and certain residues from the treatment of listed wastes typically do not pose enough of a health or environmental threat to deserve regulation as listed wastes. The principal regulatory exclusions from the mixture and derived-from rules are summarized below.

There are eight exemptions from the mixture rule. The first exemption from the mixture rule applies to mixtures of characteristic wastes and specific mining wastes excluded under §261.4(b)(7). This narrow exemption allows certain mixtures to qualify as nonhazardous wastes, even if the mixtures exhibit one or more hazardous waste characteristics. The module entitled Solid and Hazardous Waste Exclusions will explain in more detail the mining waste or Bevill exclusion.

The remaining exemptions from the mixture rule apply to certain listed hazardous wastes that are discharged to wastewater treatment facilities (§261.3(a)(2)(iv)). Many industrial facilities produce large quantities of nonhazardous wastewaters as their primary wastestreams. These wastewaters are typically discharged to a water body or local sewer system after being treated to remove pollutants, as required by the Clean Water Act. At many of these large facilities, on-site cleaning, chemical spills, or laboratory operations also create relatively small secondary wastestreams that are hazardous due to listings or characteristics. For example, a textile plant producing large quantities of nonhazardous wastewater can generate a secondary wastestream of

listed spent solvents from cleaning equipment. Routing such secondary hazardous wastestreams to the facility's wastewater treatment system is a practical way of treating and getting rid of these wastes. This management option triggers the mixture rule, however, since even a very small amount of a listed wastestream combined with very large volumes of nonhazardous wastewater causes the entire mixture to be listed. EPA provided exemptions from the mixture rule for a number of these situations where relatively small quantities of listed hazardous wastes are routed to large-volume wastewater treatment systems. To qualify for this exemption from the mixture rule, the amount of listed waste introduced into a wastewater treatment system must be very small (or de minimis) relative to the total amount of wastewater treated in the system, and the wastewater system must be regulated under the Clean Water Act.

DERIVED-FROM RULE EXEMPTIONS

There are five regulatory exemptions from the derived-from rule. The first of these derived-from rule exemptions applies to materials that are reclaimed from hazardous wastes and used beneficially. Many listed and characteristic hazardous wastes can be recycled to make new products or be processed to recover usable materials with economic value. Such products derived from recycled hazardous wastes are no longer solid wastes. Using the hazardous waste identification process discussed at the beginning of this module, if the materials are not solid wastes, then whether they are derived from listed wastes or whether they exhibit hazardous characteristics is irrelevant. The module entitled Definition of Solid Waste and Hazardous Waste Recycling will explain which residues derived from hazardous wastes actually cease to be wastes and qualify for this exemption.

The other four exemptions from the derived-from rule apply to residues from the treatment of specific wastes using specific treatment processes. For example, K062 describes spent pickle liquor from the iron and steel industry. Pickle liquor is an acid solution used to finish the surface of steel. When pickle liquor is spent and becomes a waste, it usually contains acids and toxic heavy metals. This waste can be treated by mixing it with lime to form a sludge. This treatment, called stabilization, neutralizes the acids in the pickle liquor and makes the metals less dangerous by chemically binding them within the sludge. EPA studied this process and determined that K062 treated in this manner no longer poses enough of a threat to warrant hazardous waste regulation. Therefore, lime-stabilized waste pickle liquor sludge derived from K062 is not a listed hazardous waste. The other exemptions from the derived-from rule for listed wastes are also quite specific and include: waste derived-from the burning of exempt recyclable fuels, biological treatment sludge derived-from treatment of K156 and K157, catalyst inert support media separated from K171 and K172, and residues from high temperature metal recovery of K061, K062, and F006, provided certain conditions are met.

DELISTING

The RCRA regulations provide another form of relief from the mixture and derived-from rule principles for listed hazardous wastes. Through a site-specific process known as "delisting," a waste handler can submit to EPA a petition demonstrating that while a particular wastestream generated at their facility may meet a hazardous waste listing description, it does not pose sufficient hazard to deserve RCRA regulation (§260.22). If EPA grants such a petition, the

particular wastestream at that facility will not be regulated as a listed hazardous waste. Because the delisting process is difficult, time-consuming, and expensive, it is not considered a readily available exception to the mixture and derived-from from rules.

The hazardous waste listings, the hazardous waste characteristics, and the mixture and derived-from rules are all essential parts of the definition of hazardous waste, but these key elements are all described in different sections of the RCRA regulations. Only one regulatory section, §261.3, unites all four elements to establish the formal definition of hazardous waste. This section is entitled Definition of Hazardous Waste. Section 261.3 states that all solid wastes exhibiting one of the four hazardous characteristics defined in Part 261, Subpart C, are hazardous wastes. This section also states that all solid wastes listed on one of the four hazardous waste lists in Part 261, Subpart D, are hazardous wastes. Finally, this section explains in detail the mixture and derived-from rules and the regulatory exemptions from these rules. Thus, although §261.3 is entitled Definition of Hazardous Waste, it serves primarily as a guide to the mixture and derived-from rules. Substantive rules about the two most crucial elements of the hazardous waste definition, the listings and characteristics, are found elsewhere.

2.7 THE CONTAINED-IN POLICY

The contained-in policy is a special, more flexible version of the mixture and derived-from rules that applies to environmental media and debris contaminated with hazardous waste. Environmental media (singular, "medium") is the term EPA uses to describe soil, sediments, and groundwater. Debris is a term EPA uses to describe a broad category of larger manufactured and naturally occurring objects that are commonly discarded (§268.2(g)). Examples of debris include:

- dismantled construction materials such as used bricks, wood beams, and chunks of concrete
- decommissioned industrial equipment such as pipes, pumps, and dismantled tanks
- other discarded manufactured objects such as personal protective equipment (e.g., gloves, coveralls, eyewear)
- large, naturally occurring objects such as tree trunks and boulders.

Environmental media and debris are contaminated with hazardous waste in a number of ways. Environmental media are usually contaminated through accidental spills of hazardous waste or spills of product chemicals which, when spilled, become hazardous wastes. Debris can also be contaminated through spills. Most debris in the form of industrial equipment and personal protective gear becomes contaminated with waste or product chemicals during normal industrial operations. Contaminated media and debris are primary examples of "remediation wastes." In other words, they are not wastestreams created during normal industrial or manufacturing operations. They are typically created during cleanups of contaminated sites and during the decommissioning of factories. Handlers of contaminated media and debris usually cannot

control or predict the composition of these materials, which have become contaminated though accidents or past negligence. In contrast, handlers of "as-generated wastes," the term often used to describe chemical wastestreams created during normal industrial or manufacturing operations, can usually predict or control the creation of these wastes through the industrial process. Examples of as-generated wastes include concentrated spent chemicals, industrial wastewaters, and pollution control residues such as sludges.

The hazardous waste identification principles you have learned, including the mixture and derived-from rules, apply to as-generated industrial wastes. EPA decided that a more flexible version of these principles should apply to the primary remediation wastes: environmental media and debris. In particular, EPA determined that strict application of the mixture and derived-from rules was inappropriate for media and debris, especially when listed wastes were involved. Applying the mixture and derived-from rules to media and debris would present certain disadvantages, as the following examples illustrate. First, under the traditional mixture and derived-from rules, environmental media and debris contaminated with any amount of listed hazardous waste would be forever regulated as hazardous. Such a strict regulatory interpretation would require excavated or dismantled materials to be handled as listed hazardous wastes and could discourage environmental cleanup efforts. Second, most spills of chemicals into soil or groundwater produce very large quantities of these media containing relatively low concentrations of chemicals. Strict application of the mixture and derived-from principles to media would therefore cause many tons of soil to be regulated as listed hazardous waste despite containing low concentrations of chemicals and posing little actual health threat. Finally, one of the main benefits of the mixture and derived-from rules is not relevant to media and debris. The mixture and derived-from principles encourage handlers of as-generated wastes to keep their listed wastes segregated from less hazardous wastestreams to avoid creating more listed wastes. Handlers of contaminated media and debris generally have no control over the process by which these materials come into contact with hazardous waste.

For all of the above reasons, EPA chose to apply a special, more flexible, version of the mixture and derived-from rules to environmental media and debris. Contaminated soil, groundwater, and debris can still present health threats if they are not properly handled and/or disposed. Therefore, EPA requires that any medium and debris contaminated with a listed waste or exhibiting a hazardous characteristic be regulated like any other hazardous waste. Media and debris contaminated with listed hazardous wastes can, however, lose their listed status and become nonhazardous. This occurs after a demonstration that the particular medium or debris in question no longer poses a sufficient health threat to deserve RCRA regulation. The requirements for making this demonstration are explained below. Once the demonstration is made, the medium or debris in question is no longer considered to "contain" a listed hazardous waste and is no longer regulated. In addition, contaminated media that contain a waste listed solely for the characteristics of ignitability, corrosivity, and/or reactivity, would no longer be managed as a hazardous waste when no longer exhibiting a characteristic (66 FR 27266, 27286; May 16, 2001). This concept that media and debris can contain or cease to contain a listed hazardous waste accounts for the name of the policy.

The contained-in policy for environmental media is not actually codified in the RCRA regulations. In legal terms, it is merely a special interpretation of the applicability of the mixture

and derived-from rules to soil and groundwater that has been upheld in federal court. These principles for the management of contaminated media are therefore known as a policy instead of a rule. The terms of the contained-in policy are relatively general. In order for environmental medium contaminated with a listed waste to no longer be considered hazardous, the handler of that media must demonstrate to EPA's satisfaction that it no longer poses a sufficient health threat to deserve RCRA regulation. Although handlers of listed media must obtain EPA's concurrence before disposing of such media as nonhazardous, the current contained-in policy provides no guidelines on how this demonstration to EPA should be made. The contained-in policy is a far easier option for eliminating unwarranted hazardous waste regulation for low-risk listed wastes than the process of delisting a hazardous waste mentioned previously. The delisting process demands extensive sampling and analysis, submission of a formal petition, and a complete rulemaking by EPA. A determination that an environmental medium no longer contains a listed hazardous waste can be granted on a site-specific basis by EPA officials without any regulatory procedure.

Debris contaminated with hazardous waste has traditionally been governed by the same nonregulatory contained-in policy explained above. In 1992, EPA codified certain aspects of the contained-in policy for debris in the definition of hazardous waste regulations in §261.3(f) (57 FR 37194, 34225; August 18, 1992). In particular, EPA included a regulatory passage that explains the process by which handlers of debris contaminated with listed hazardous waste can demonstrate that the debris is nonhazardous. This passage also references certain treatment technologies for decontaminating listed debris so that it no longer contains a listed waste. Thus, the term contained-in policy is now something of a misnomer for contaminated debris, since a contained-in rule for debris now exists.

3. REGULATORY DEVELOPMENTS

The hazardous waste identification process is subject to critical review, and adjusted accordingly to reflect technology changes and new information. The hazardous waste listings are particularly dynamic as the Agency conducts further research to incorporate new listings. The following is a brief discussion of several developments to hazardous waste identification.

3.1 THE HAZARDOUS WASTE IDENTIFICATION RULES

EPA proposed to significantly impact the RCRA hazardous waste identification process through a rulemaking effort called the Hazardous Waste Identification Rules (HWIR). The first rule, HWIR-media, was finalized on November 30, 1998, and addressed contaminated media (63 FR 65874). The second rule, HWIR-waste, was finalized on May 16, 2001, and modified the mixture and derived-from rules, as well as the contained-in policy for listed wastes (66 FR 27266). Both the HWIR-media rule, and the HWIR-waste rule, attempt to increase flexibility to the hazardous waste identification system by providing a regulatory mechanism for certain hazardous wastes with low concentrations of hazardous constituents to exit the Subtitle C universe.

The final HWIR-media rule addresses four main issues. First, the Agency promulgated a streamlined permitting process for remediation sites that will simplify and expedite the process of obtaining a permit. Second, EPA created a new unit, called a "staging pile," that allows more flexibility when storing remediation wastes during cleanups. Third, the Agency promulgated an exclusion for dredged materials permitted under the Clean Water Act, or the Marine Protection, Research, and Sanctuaries Act. Fourth, the rule finalized provisions that enable states to more easily receive authorization when their RCRA programs are updated in order to incorporate revisions to the federal RCRA regulations. The HWIR-media rule did not incorporate the provisions that would have removed low risk remediation waste from Subtitle C regulations because of fundamental disagreements between stakeholders.

On July 18, 2000, the Agency released HWIR-waste exemption levels for 36 chemicals that were developed using a risk model known as the Multimedia, Multipathway and Multireceptor Risk Assessment (3MRA) Model (65 FR 44491). EPA is currently reviewing the public comments and will decide whether further revisions to the model are necessary. After completion of independent testing, EPA submitted the model to EPA's Science Advisory Board (SAB) for review during 2003.

The May 16, 2001, HWIR-waste rule revised and retained the hazardous waste mixture and derived-from rules as previously discussed in this module. In addition, the rule finalized provisions that conditionally exempt mixed waste (waste that is both radioactive and hazardous), if the mixed waste meets certain conditions in Part 266 (66 FR 27266).

3.2 FINAL HAZARDOUS WASTE LISTING DETERMINATIONS

EPA first signed a proposed consent decree with the Environmental Defense Fund (EDF) on June 18, 1991, following a suit concerning EPA's obligations to take certain actions pursuant to RCRA. A consent decree is a legally binding agreement, approved by the Court, which details the agreements of the parties in settling a suit. The proposed consent decree, commonly known as the "mega-deadline," settles some of the outstanding issues from the case by creating a schedule for EPA to take action on its RCRA obligations. The consent decree, which has been periodically updated, requires EPA to evaluate specified wastestreams and determine whether or not to add them to the hazardous waste listings.

On November 8, 2000, EPA listed as hazardous two wastes generated by the chlorinated aliphatics industry (65 FR 67068). The two wastes are K174, wastewater treatment sludges from the production of ethylene dichloride or vinyl chloride monomer (EDC/VCM), and K175, wastewater treatment sludges from the production of vinyl chloride monomer using mercuric chloride catalyst in an acetylene-based process. For K174, EPA finalized a contingent-management listing approach which specifies that the waste will not be listed if it is sent to a Subtitle C landfill or a non-hazardous landfill licensed or permitted by the state or federal government.

On November 20, 2001, EPA published a final rule listing three wastes generated from inorganic chemical manufacturing processes as hazardous wastes (66 FR 58257). The three wastes are K176, baghouse filters from the production of antimony oxide; K177, slag from the production of antimony oxide that is speculatively accumulated or disposed; and K178, residues from manufacturing and manufacturing-site storage of ferric chloride from acids formed during the production of titanium dioxide using the chloride-ilmenite process.

EPA proposed a concentration-based hazardous waste listing for certain waste solids and liquids (K180 and K179) generated from the production of paint on February 13, 2001 (66 FR 10060). Following a review of the public comments and supplemental analyses based on those public comments, EPA determined that the paint wastes identified in the proposal do not present a substantial hazard to human health or the environment. Therefore, EPA did not list these paint production wastes as hazardous. See the April 4, 2002, final determination regarding these hazardous waste listings (67 FR 16261) for additional information.

On February 24, 2005, EPA published a final rule listing nonwastewaters from the production of certain dyes, pigments, and food, drug, and cosmetic colorants (70 FR 9138) as hazardous (K181) using a mass loading-based approach. Under the mass loading approach, these wastes are hazardous if they contain any of the constituents of concern at annual mass loading levels that meet or exceed the regulatory levels. The K181 listing focuses on seven hazardous constituents: aniline, o-anisidine, 4-chloroaniline, p-cresidine, 1,2-phenylenediamine, 1,3-phenylenediamine, and 2,4-dimethylaniline. Waste that contains less than the specified threshold levels of constituents of concern are not hazardous. The K181 listing is EPA’s final obligation under the consent decree.

3.3 PROPOSED REVISION TO WASTEWATER TREATMENT EXEMPTION FOR HAZARDOUS WASTE MIXTURES

On April 8, 2003, EPA proposed to add benzene and 2-ethoxyethanol to the list of solvents whose mixtures with wastewater are exempted from the definition of hazardous waste (68 FR 17234). EPA is proposing to provide flexibility in the way compliance with the rule is determined by adding the option of directly measuring solvent chemical levels at the headworks of the wastewater treatment system. In addition, EPA is proposing to include scrubber waters derived from the combustion of spent solvents to the headworks exemption. Finally, EPA is proposing to extend the de minimis exemption to wastes listed in §§261.31 and 261.32 when released in de minimis quantities and to non-manufacturing facilities if certain conditions are met. The final rule is scheduled to be published in the Fall of 2005.

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INCOMPATIBLE MATERIALS CHART

HMUG GROUP	MATERIAL GROUP	EXAMPLES	INCOMPATIBLE MATERIALS	EXAMPLES	REACTION IF MIXED
1	ACIDS	Battery Acid Paint Removers De-Rust Sprays	FLAMMABLES/COMBUSTIBLES ALKALIES/BASES/CAUSTICS OXIDIZERS (HMUG GROUPS 2, 3, 6, 7, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 22)	Degreasers, Carbon Removers Antifogging Compounds	HEAT GAS GENERATION VIOLENT REACTION
2	ADHESIVES	Epoxies Isocyanates Diethylenetriamine	ACIDS ALKALIES/BASES/CAUSTICS OXIDIZERS (HMUG GROUPS 1, 3, 18)		HEAT FIRE HAZARD
3	ALKALIES/ BASES/ CAUSTICS	Ammonia Sodium Hydroxide Sodium Bicarbonate Cleaners/Detergents	ACIDS/OXIDIZERS FLAMMABLES/COMBUSTIBLES (HMUG GROUPS 1, 2, 6, 8, 9, 10, 11, 12, 14, 15, 17, 18, 19, 20, 22)	Battery Acid, Paint Removers, De-Rust Sprays, Paints/Solvents	HEAT GAS GENERATION VIOLENT REACTION
4	CLEANING COMPOUNDS	Degreasers Carbon Removers Antifogging Compounds	DETERGENTS/SOAPS OXIDIZERS (HMUG GROUPS 7, 18)	Calcium Hypochlorite, Sodium Nitrate, Hydrogen Peroxide	HEAT FIRE HAZARD
5	COMPRESSED GASES	Acetylene Helium Propane Ammonia Oxygen	HEAT SOURCES CONSULT OPNAVINST 5100.19 (SERIES) AND NSTM 670 FOR SPECIFIC HANDLING AND STOWAGE GUIDANCE		FIRE HAZARD EXPLOSION HAZARD
6	CORROSION PREVENTIVE COMPOUNDS	Corrosion Inhibitors Chemical Conversion Compounds	ACIDS BASES OXIDIZERS IGNITION SOURCES (HMUG GROUPS 1, 3, 18)		FIRE HAZARD
7	DETERGENTS/ SOAPS	Detergents, Disinfectant, Scouring Powders, Sodium Hydroxide, Trisodium Phosphate, Potassium Hydroxide, (Alkalies/Bases/Caustics)	ACID-CONTAINING COMPOUNDS (HMUG GROUPS 1, 4, 5)	Battery Acid, Paint Removers, De-Rust Sprays,	VIOLENT REACTION HEAT
8	GREASES	Graphite Silicone Molybdenum	OXIDIZERS ALKALIES/BASES/ CAUSTICS (HMUG GROUPS 3, 18)		FIRE HAZARD
9	HYDRAULIC FLUIDS	Petroleum-Based Synthetic Fire-Resistant	CORROSIVES (HMUG GROUPS 1, 3) OXIDIZERS (HMUG GROUP 18)		HEAT VIOLENT REACTION
10	INSPECTION PENETRANTS	Petroleum-Based Dyes	CORROSIVES (HMUG GROUPS 1, 3) OXIDIZERS (HMUG GROUP 18)	Battery Acid Chlorine Laundry Bleach Calcium Hypochlorite Calcium Oxide Hydrogen Peroxide OBA Canisters Lithium Hydroxide Ammonia Paint Removers	EXPLOSION HAZARD
11	LUBRICANTS/ OILS	Gen. Purpose, Turbine, Gear, Vacuum, Weapon	CORROSIVES (HMUG GROUPS 1, 3) OXIDIZERS (HMUG GROUP 18)		
12	PAINTS	Primers, Enamels, Lacquers, Strippers, Varnish, Thinners	OXIDIZERS (HMUG GROUP 18) CORROSIVES (HMUG GROUPS 1, 3)		HEAT FIRE HAZARD
13	PHOTO CHEMICALS	Color and B/W Developers, Bleaches/Stopbath Replenishers, Toners	ACIDS HEAVY METALS (HMUG GROUPS 1, 20)		HEAT FIRE HAZARD
14	POLISH/WAX COMPOUNDS	Buffing Compound Metal Polish Gen. Purpose Wax	CORROSIVES OXIDIZERS (HMUG GROUPS 1, 3, 18)		HEAT, FIRE HAZARD VIOLENT REACTION
15	SOLVENTS (HYDROCARBONS)	Acetone, Methyl Ethyl Ketone (MEK), Toluene, Xylene, Alcohols	CORROSIVES OXIDIZERS BATTERIES (HMUG GROUPS 1, 3, 18, 21)	Battery Acid Calcium Hypochlorite Sodium Nitrate Hydrogen Peroxide Sodium Hydroxide	HEAT FIRE HAZARD
16	THERMAL INSULATION	Asbestos Fibrous Glass Man-Made Vitreous Fibers	MATERIAL IS NOT REACTIVE KEEP DRY		NO REACTION
17	WATER TREATMENT CHEMICALS	Tri-Sodium Phosphate Caustic Soda Hardness Buffer Citric/Nitric Acid Titrating Solutions	CORROSIVES OXIDIZERS HEAVY METALS (HMUG GROUPS 1, 3, 18, 20)		HEAT VIOLENT REACTION
18	OXIDIZERS	Chlorine Laundry Bleach Calcium Hypochlorite Calcium Oxide Hydrogen Peroxide OBA Canisters Lithium Hydroxide	PETROLEUM BASED MATERIALS FUELS, SOLVENTS, CORROSIVES, HEAT (HMUG GROUPS 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 15, 17, 19, 20, 21, 22)		FIRE HAZARD TOXIC GAS GENERATION
19	FUELS	JP4, JP5, Gasoline	CORROSIVES OXIDIZERS (HMUG GROUPS 1, 3, 18)	Battery Acid Calcium Hypochlorite Sodium Nitrate Sodium Hydroxide	FIRE HAZARD TOXIC GAS GENERATION
20	HEAVY METALS	Beryllium, Chromium, Copper, Lead, Magnesium, Mercury, Nickel, Strontium Chromate, Tin, Zinc	CORROSIVES OXIDIZERS WATER TREATMENT/ PHOTO CHEMICALS (HMUG GROUPS 1, 3, 6, 13, 17, 18, 21)		VIOLENT REACTION GENERATION OF TOXIC AND FLAMMABLE GAS
21	BATTERIES	Lead Acid Alkaline Lithium Dry Cell	SOLVENTS HEAVY METALS OXIDIZERS (HMUG GROUPS 15, 18, 20)	Xylene Toluene Alcohol Tin Zinc Chromium	HEAT VIOLENT REACTION TOXIC GAS GENERATION
22	PESTICIDES	Insecticides Fungicides Rodenticides Fumigants	CORROSIVES OXIDIZERS (HMUG GROUPS 1, 3, 18)		TOXIC GAS GENERATION

1. This Chart is to be used as a ***Guide Only!***
2. Compare the desired HMUG Group in the Left Column with the Incompatible Material(s) of that Group in the Center Column, on the same row.
3. Should the Material(s) in the Center Column be mixed with the desired Group in the Left Column, the Expected Reaction(s) can be see in the Right Column.
4. For ***specific information*** on storage of Hazardous Materials, consult the MSDS, HMUG, OPNAVINST 5100.19 (Series), NSTM 670, Ships Hazardous Material List (SHML), and NAVSUP PUB 573.

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APPENDIX V TO PART 264—EXAMPLES OF POTENTIALLY INCOMPATIBLE WASTE

Many hazardous wastes, when mixed with other waste or materials at a hazardous waste facility, can produce effects which are harmful to human health and the environment, such as (1) heat or pressure, (2) fire or explosion, (3) violent reaction, (4) toxic dusts, mists, fumes, or gases, or (5) flammable fumes or gases.

In the lists below, the mixing of a Group A material with a Group B material may have the potential consequence as noted.

GROUP 1–A
Acetylene sludge
Alkaline caustic liquids
Alkaline cleaner
Alkaline corrosive liquids
Alkaline corrosive battery fluid
Caustic wastewater
Lime sludge and other corrosive alkalies
Lime wastewater
Lime and water
Spent caustic

GROUP 1–B
Acid sludge
Acid and water
Battery acid
Chemical cleaners
Electrolyte, acid
Etching acid liquid or solvent
Pickling liquor and other corrosive acids
Spent acid
Spent mixed acid
Spent sulfuric acid

Heat generation; violent reaction.

GROUP 2–A
Aluminum
Beryllium
Calcium
Lithium
Magnesium
Potassium
Sodium
Zinc powder
Other reactive metals and metal hydrides

GROUP 2–B
Any waste in Group 1–A or 1–B

Fire or explosion; generation of flammable hydrogen gas.

GROUP 3–A
Alcohols, Water

GROUP 3–B
Any concentrated waste in Groups 1–A or 1–B
Calcium
Lithium
Metal hydrides
Potassium
SO_2 Cl_2, $SOCl_2$, PCl_3, CH_3 $SiCl_3$
Other water-reactive waste

Fire, explosion, or heat generation; generation of flammable or toxic gases.

GROUP 4–A
Alcohols
Aldehydes
Halogenated hydrocarbons
Nitrated hydrocarbons
Unsaturated hydrocarbons
Other reactive organic compounds and solvents

GROUP 4–B
Concentrated Group 1–A or 1–B wastes
Group 2–A wastes

Fire, explosion, or violent reaction.

GROUP 5–A
Spent cyanide and sulfide solutions

GROUP 5–B
Group 1–B wastes

Generation of toxic hydrogen cyanide or hydrogen sulfide gas.

GROUP 6–A
Chlorates, Chlorine, Chlorites
Chromic acid
Hypochlorites
Nitrates
Nitric acid, fuming
Perchlorates
Permanganates
Peroxides
Other strong oxidizers

GROUP 6–B
Acetic acid and other organic acids
Concentrated mineral acids
Group 2–A wastes
Group 4–A wastes
Other flammable and combustible wastes

Fire, explosion, or violent reaction.

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July 2005

Final Report

Laboratory Waste Management Guide

Dave Waddell
Local Hazardous Waste Management Program in King County
Technical Assistance and Pollution Prevention Team

This report was prepared by the Local Hazardous Waste Management Program in King County, Washington. The program seeks to reduce hazardous waste from households and small quantity generator businesses in King County by providing information and technical assistance to protect human health and the environment.

For more information or to order additional copies of this report contact:

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INTRODUCTION

The first edition of this management guide, published in 1994, was prepared by representatives from several groups: the King County Water and Land Resources Division, the Local Hazardous Waste Management Program in King County, the Northwest Laboratory Coalition, and the Washington Biotechnology Association. Baz Stevens from King County's Industrial Waste Section (formerly the Municipality of Metropolitan Seattle) was one of the original authors.

The management guide is part of a comprehensive program to reduce the amount of hazardous waste generated by businesses and the metals and chemical contaminants improperly disposed into waters and landfills. This is the fourth edition of the management guide.

This edition addresses a broader range of issues and waste streams than was covered in the original document. The practices recommended in these guidelines will help analytical, medical, teaching, and biotechnology labs properly manage hazardous materials and reduce hazardous waste.

The guidelines also help businesses and agencies in King County decide whether their waste may be acceptable for discharge to the sewer. For more help, see the contacts listed in the *For More Information* section of this report. Though the specific focus is King County, many of the recommendations are applicable to labs anywhere in the United States.

These guidelines do not provide authorization under Permit by Rule (WAC 173-303-802) to allow discharge of hazardous chemicals to the sewer. They serve, in part, as a guideline to assist businesses and agencies in King County in determining whether their waste may be acceptable for discharge to the sewer.

FACILITY MANAGEMENT

Drain Protection

Solutions discharged into the sewer system flow to wastewater treatment facilities that have limited capacity to remove chemical contaminants. Most areas in King County discharge to facilities that are maintained and operated by King County Department of Natural Resources and Parks. Rain and other runoff into storm drains usually flow directly to creeks and waterways that drain to Puget Sound with no treatment. It is important to protect both storm drains and the sewer system from chemicals and other pollutants. In a sense, all the best management practices in this handbook are intended to provide "drain protection"--or water quality protection.

To protect your drains:

- Do not hold or store chemicals in sinks. Use tubs, containers or storage lockers instead.
- Post laminated signs by sinks listing wastes that cannot be poured down the drain from nearby lab processes.
- Provide spill and leak protection around all sinks, especially cup sinks on countertops and under hoods where hazardous materials are used or stored.
- Provide secondary containment trays or tubs for reagents being temporarily stored in fume hoods with cup sink drains.
- Block floor drains in areas where chemicals are used or stored.
- Keep enough material on hand to prevent and clean up spills. These supplies may include absorbents, drain plugs, acid and base neutralizers, goggles, gloves, respirators with chemical specific cartridges, and waste collection containers. Make sure clean-up materials and copies of the emergency response plan and emergency phone numbers are readily available.
- Provide secondary containment for carboys and bottles on floors holding analytical reagents and wastes from analytical instruments.
- Periodically flush cup sink drains with water to keep sewer gases from passing through a dry p-trap.

Safety Showers

Prevent spilled chemicals from reaching safety shower drains. Possible methods include:

- Eliminate the drain.
- Cover or plug the drain when not in use to prevent accidental discharge.

- Install a temporary plug that opens automatically when the safety shower is turned on (this can be done by linking the lever action that activates the shower to one that lifts the plug.)
- See the *Spill Management* section for information on preventing spilled chemicals from spreading.

Should contaminants washed off a person during emergency use of a safety shower be allowed in a drain? When hazardous chemicals are spilled on a worker, the first priority is to flush the contaminants off the person. If steps can be taken to limit the amount of hazardous chemicals entering the floor drain without interfering with speedy emergency response, do so.

If not, as soon as possible notify the local sewer agency that there has been a release. Post the local sewer agency's phone number near the safety shower and in your spill response guide. Check in the blue pages of your phone book for this phone number and look for the words "Sewer" or "Wastewater" under the name of your city or county.

Chemical Storage

Laboratories generally use a variety of toxic, corrosive, reactive and flammable materials. If these are stored close together in fragile containers, there is a risk of breakage and spills that release materials to the environment. Proper storage of chemicals requires the use of prudent handling and storing practices and a well-constructed lab facility.

Components of a Safe and Effective Chemical Storage Area

- Maintain an inventory of chemicals stored in each lab.
- Anchor hazardous material storage cabinets to walls.
- Close and latch doors on storage cabinets.
- Provide separate corrosion-free cabinets for flammable liquids, concentrated inorganic acids and caustic liquid bases.
- Keep a Class ABC fire extinguisher near locations where chemicals are stored or used and train employees in its operation.
- Provide secondary containment for chemicals stored on counters and near drains.

Storing and Handling Chemicals

- Store incompatible materials separately. Several concentrated organic acids are combustible and are more safely stored with flammable liquids than with sulfuric acid and nitric acid that are powerful oxidizers. Refer to the *Incompatible Chemicals* section below for further information on safer chemical storage.
- Reduce the risk of bottle breakage. Whenever possible, order concentrated acids and flammable solvents in plastic-coated bottles. Small containers are more durable and less

likely to break than large ones. Use rubber or plastic bottle carriers or bottle jackets when transporting glass containers.

- Keep containers closed when not in use so contents cannot evaporate or escape a tipped container.
- Return chemicals to their proper place after use or at least before leaving the work station at the end of the day.
- Properly label containers with the name of the compound and its primary hazards. Chemical symbols alone are insufficient identification.
- Regularly check expiration dates on chemicals. Dispose of them or use them promptly and properly.
- Write the date received on each chemical container that arrives and the date opened on all containers of peroxidizable solvents.
- Avoid storing chemicals in fume hoods. They interfere with the air flow, clutter work space and could potentially spill into cup sink drains.
- Avoid storing chemicals on bench tops.
- Properly store or dispose of all hazardous materials before leaving the workstation.
- Avoid storing chemicals under sinks.
- Do not store flammable liquids in domestic refrigerators or freezers. Use only "lab-safe" equipment with external thermostats, manual defrosting, etc.

Systematic Storage of Lab Chemicals

We suggest following the storage and handling guidelines found in *Prudent Practices in the Laboratory* by the National Research Council's Committee on Hazardous Substances in the Laboratory (National Academy Press, Washington, DC, 1995).

Many universities publish diagrams of their chemical storage system on their Web sites. These are often based on the storage system published in the National Research Council's *Prudent Practices in the Laboratory*. Two chemical supply companies, J.T. Baker and Flinn Scientific Inc., also have popular systems for chemical storage that incorporate the concept of "related and compatible storage groups" found in *Prudent Practices.*

These systems are based on a series of codes for functional classes of chemicals. Organic and inorganic chemicals are separated, with sub-groups further separated. The "related and functional storage groups listed in *Prudent Practices*" and the shelf storage codes often assigned to these groups are listed below. ("I" refers to inorganic compounds and "O" refers to organic compounds.)

I-1 Metals, hydrides

I-2 Halides, sulfates, sulfites, thiosulfates, phosphates, halogens

I-3 Amides, nitrates (except ammonium nitrate), nitrites, azides

I-4 Hydroxides, oxides, silicates, carbonates, carbon

I-5 Sulfides, selenides, phosphides, carbides, nitrides

I-6 Chlorates, perchlorates, chlorites, hypochlorites, peroxides

I-7 Arsenates, cyanides, cyanates

I-8 Borates, chromates, manganates, permanganates

I-9 Inorganic acids

I-10 Sulfur, phosphorus, arsenic, phosphorus pentoxide

O-1 Organic acids anhydrides, peracids

O-2 Alcohols, glycols, amines, amides, imines, imides

O-3 Hydrocarbons, esters, aldehydes

O-4 Amines, imines, pyridine

O-5 Ethers, ketones, ketenes, halogenated hydrocarbons, ethylene oxide

O-6 Epoxy compounds, isocyanates

O-7 Organic peroxides, hydroperoxides, azides

O-8 Sulfides, polysulfides, sulfoxides, nitriles

O-9 Phenols, cresols

Flammable liquids must be stored in flammable storage cabinets or fire safety cans. Alphabetical storage is discouraged except within compatible groups.

Most guidelines have adapted this list to create a systematic shelf storage system. Unfortunately, this system is confusing to implement. For example, many of the listed chemicals are hazardous liquids that should be stored in specialized cabinets rather than on shelves. The system is also difficult to implement for secondary schools and other labs with limited storage space: most stockrooms are too small to accommodate a system that has 19 separated shelves (plus storage cabinets.)

For labs with restricted storage spaces, compatible storage can be provided by grouping chemicals with similar hazards together. These labs could use a simplified system like the one illustrated in Table 1.

Table 1 –Shelf Storage Pattern for Small Stockrooms

Inorganic Shelves	Organic Shelves
I-1 & I-10 – Sulfur, phosphorus, arsenic, metals, hydrides (store all away from water!)	O-1 – Dry and dilute organic acids, anhydrides, peracids
I-2 – Halides, sulfates, sulfites, thiosulfates, phosphates, halogens	O-5 & O-7 – Organic peroxides, azides
I-5 & I-7 – Sulfides, selenides, phosphides, carbides, nitrides, arsenates, cyanides	O-6 & O-8 – Epoxy compounds, isocyanates, sulfides, sulfoxides, nitriles
I-4 – Dry hydroxides, oxides, silicates, carbonates	O-9 – Miscellaneous organics: Powdered and alcohol-free stains and indicators.
I-3, I-6 & I-8 – Nitrates, nitrites, borates, chromates, manganates, permanganates, chlorates, chlorites, inorganic peroxides	
	Flammable Storage Cabinet – Hydrocarbons, ethers, ketones, amines, halogenated hydrocarbons, aldehydes, alcohols, glycols, phenol, cresol, combustible organic acids, combustible anhydrides
Corrosive Acid Storage Cabinet – Inorganic acids. Nitric acid stored separately in this or another cabinet	Corrosive Base Storage Cabinet or Cupboard – Concentrated inorganic hydroxides
***Notes**: Keep water reactive metals away from aqueous solutions and alcohols. Use secondary containers to separate yellow and white phosphorus, which are stored under water, from water-reactive metals.*	

Preparing Your Laboratory for Earthquakes

- Lips on shelves provide some restraint for bottles in an earthquake, but are inadequate when there is violent shaking. Having doors on chemical storage cupboards is recommended. Unsecured cupboard doors can open during earthquakes. They should be fitted with locking latches.
- Shelf lips should be between one and two inches in height. Excessively high lips can make it difficult to remove bottles, increasing the risk of losing one's grip on them. Lips that are too low do little to restrain bottles from falling off shelves.
- Some shelf anchors can fail. They should be designed to restrain full, rather than empty, shelves. Additionally, many shelf clips become corroded over time due to exposure to acid vapors. Inspect shelf anchors annually. Those with more than a patina of rust should be promptly replaced.
- Anchor large laboratory equipment and shelves to walls. Incubators, biosafety cabinets, corrosive and flammable storage cabinets, freezers and refrigerators, and storage shelves can fall over or collapse. In addition, these items also have "movement" potential, and can prevent emergency access to, and egress from, occupied spaces.
- On a side note: here's a recommendation from the Stanford School of Medicine's website: *"**A word about biological cultures**: Any earthquake that requires the evacuation of a building can put valuable research material at risk. Very little is more frustrating than to*

come back to a building (perhaps after several days or a week) to find the infrastructure sound, equipment in good shape, but cultures non-viable. Loss of culture material can set back both research and careers if steps are not taken to back up material whenever possible. If lyophilization (and storage off site) is not possible, try to work out a "deal" with out-of-state colleagues to store duplicates of each other's cultures (fires and other Acts-of-God do not respect geographical boundaries).”

- Small anchoring devices are available, from “thumb-locking” clips to industrial strength Velcro-like strips to assist with anchoring computer printers and other equipment.
- Secure distillation apparatus and other elaborate glassware with straps and install refrigerator door clasps.
- Following an earthquake, use caution when entering rooms with closed doors and when opening cabinets and cupboards. Containers may have broken, and toxic, flammable or corrosive vapors may be in the cabinet, cupboard or room. The first assessment of damage to rooms containing chemicals should be done by personnel trained in emergency response and wearing appropriate personal protective equipment.

Planning for Renovation and New Construction

- Avoid putting chemical storage shelves or cabinets over sinks. Accidental spills or breakage could release chemicals to the sewer.
- If you install a house vacuum system, use dry-seal or non-contact water pumps. Pumps that use contact water may discharge chemicals to the sewer.
- If a safety shower discharges to a laboratory floor drain, construct the drain in an appropriately-sized sump with a standpipe to prevent spilled chemicals from going down the drain while allowing water from the shower to drain. Check with your local building code to determine whether such sumps must be double-contained.
- If available, select a sink that has a lip to provide spill protection.
- Contact the local plumbing inspector early in the process to clearly communicate to them where acidic wastes could accidentally enter drains and where they could not. This could save time and costs from having to stop the process to replace cast-iron piping with acid-resistant piping.
- Passive acid-treatment tanks are often recommended by architects in classrooms and laboratory spaces. For most situations, these systems are very difficult to manage and maintain. Sulfuric acid creates a “slime” layer in contact with limestone that requires physical agitation or high pressure rinsing to remove. Once the slime layer is in place, the limestone chips no longer neutralize acidic wastewaters. This could damage downstream side-sewer lines and lead to very expensive pavement-cutting and sewer repair projects.

Water Conservation

Structural measures, such as those listed below, can significantly reduce water use. In addition, well-trained lab workers can use their ingenuity to save water on the job.

- Install water-saving devices (such as flow restrictors) on sinks and rinse tanks.
- Reduce rinse times if possible (without affecting product quality).
- Recycle water – for example, to air scrubbers and cooling towers.
- Eliminate one-pass or continuous flow cooling systems. Consider installing heat exchangers or re-circulating cooling water systems to conserve waste cooling water.
- Overhaul faulty steam traps on steam sterilizers.
- Reverse osmosis (RO) water is commonly used in lab experiments, but the RO process is very wasteful with as much as 90 percent of the water discharged as wastewater. Some universities have recirculated this water back through the RO system or used the discarded water as non-potable water in other areas. Possible uses include flushing toilets, watering landscape plants or as cooling water for autoclaves.

Training

All laboratory staff should understand the importance of using Best Management Practices for waste reduction and environmental protection. Training for new employees and refresher training for all staff are important.

- Keep your lab's Spill Response Plan updated and available to employees.
- Post emergency numbers.
- Train lab workers in the components of the Chemical Hygiene Plan covering proper chemical handling, storage and disposal.
- Emphasize a commitment to waste prevention and proper chemical management.
- Encourage employees to develop waste prevention and waste stream efficiency ideas and then to implement them.
- Provide regular training in water conservation.

Under Chapter 296-824 WAC, any business using hazardous chemicals must develop an emergency plan that anticipates and develops responses to emergencies. The plan must be written and must address pre-emergency planning and coordination with all potential responders. The plan must also define personnel roles and ensure that employees working with hazardous chemicals receive the minimum mandatory training required for awareness of chemical hazards and/or responding to spills. See WAC 296-824-30005 for more information

about these requirements. They are enforced by the Washington Department of Labor and Industries.

The Laws and Agency Rules section of the Washington Legislature's Web site at http://www.leg.wa.gov/WAC/index.cfm?section=296-824-100&fuseaction=section links to a flow chart that helps define when training is mandated under Chapter 296-824 WAC.

CHEMICAL SPILL MANAGEMENT

Spill management plans are very dependent on the size and complexity of the facility and the diversity and comparative hazards of the chemicals being used in the lab. Excellent examples of spill management plans are available from many university's environmental health and safety program websites. A few key components should be part of every laboratory's spill response procedures:

- Differentiate between major and minor chemical spills.
- Major spills require immediate emergency response assistance. They are typically identified as difficult to contain, likely to harm personnel or posing an immediate and serious fire risk.
- Prepare for major spills by working with your local emergency responders to develop a notification and evacuation plan. At some facilities, initial response to major spills may be by the facility's trained emergency response team. For many other labs, these spills are beyond the capacity of their staff.
- Minor spills typically will be cleaned up by laboratory staff or facility-based emergency response teams.
- Only clean up minor spills when you know the chemical's name and hazards and have protective equipment and spill kits that can handle it. This points out the importance of proper labeling and spill response training.
- Spill response training should be carefully designed to distinguish between major and minor spills and between similar chemicals with different hazards. Many lab staff can easily clean up a spill of 500 milliliters of 25 percent sodium hydroxide solution. Few lab staff can safely clean up a similar spill of ammonium hydroxide. Both are corrosive bases, but ammonium hydroxide's intensely irritating vapors pose a unique hazard.
- Small labs, such as a high school science lab, should have simple, easy-to-use spill kits. The kit should contain citric acid for spills of liquid bases, sodium carbonate for acids, and granular absorbent for organic solvents. Sand is sometimes applied to increase traction in spills of slippery compounds like sulfuric acid and sodium hydroxide.
- Contact your local sewer agency to learn when they should be notified of a spill entering the sanitary sewer.

MANAGING HAZARDOUS CHEMICALS ON SITE

Incompatible Chemicals

When they come in contact with each other, incompatible chemicals could react by releasing toxic or flammable gases, exploding or spontaneously igniting. Segregate and store chemicals by hazard class to minimize the risk of reactions between incompatible chemicals and label storage cabinets and cupboards with the hazard class of the stored materials. Material safety data sheets (MSDSs) should be available for all chemicals on site. Review them for information about incompatibilities. The following is a partial list of common incompatible chemicals that can react with each other.

Acids and Bases

Store strong acids and bases separately in enclosures made of corrosion-resistant materials.

Oxidizing Chemicals

Oxidizers are materials that yield oxygen readily to stimulate the combustion of organic matter. When oxidizers come in contact with flammable solvents, they can start or fuel fires.

Typical oxidizing agents found in laboratories include chromates and dichromates, halogens and halogenating agents, peroxides and organic peroxides, nitric acid and nitrates, chlorates and perchlorates, and permanganates and persulfates.

- Store oxidizers away from alkalis, azides, nitrites, organic compounds (including acetic acid), powdered metals and activated carbon.
- Avoid contact between oxidizers and common combustible materials such as paper, cloth and wood.

Water-Reactive Compounds

Water-reactive compounds include alkali earth metals such as lithium, potassium and sodium, sodium borohydride, calcium carbide and sodium peroxide. Solutions containing water, such as inorganic acids and alcohols, should be kept separated from these chemicals during storage and use.

- Store water-reactive compounds away from aqueous solutions, inorganic acids, base solutions and alcohols. Though many chemical storage systems recommend water-reactive solids be stored in the flammable storage cabinets, in many cases this would not be prudent since these cabinets often contain alcohols with 30 percent water.
- Keep a Class D fire extinguisher near storage and use areas for these compounds.
- Store these compounds in locations protected from automated sprinklers.

- Alkali metals should be stored in areas where they are free of moisture, contact with oxygen, and, in the case of lithium, nitrogen gas.
- Only the amount of water-reactive materials necessary to perform the work should be removed from storage. Spare materials should be returned to the appropriate storage container, and the container to its appropriate location.
- Storage containers should be labeled with their contents, hazardous properties and type of oil or gas used to inert the metal. Furthermore, these containers should be stored individually or in a manner that allows visual inspection for container integrity.
- Storage areas should be free of combustibles and of ignition sources.
- The portions of the building dedicated as storage area for alkali metals should not be equipped with automatic sprinklers. No other source of water (e.g., showers, sinks) should be in the immediate proximity of the metal.
- Storage areas should be prominently labeled to indicate the presence of alkali metals.

We suggest following the storage and handling guidelines found in *Prudent Practices in the Laboratory* by the National Research Council's Committee on Hazardous Substances in the Laboratory (National Academy Press, Washington, DC, 1995).

Both J.T. Baker and Flinn have established systems for chemical storage.

Potentially Explosive Chemicals

Several classes of chemicals may become explosive when they react with other compounds or may become unstable during storage. Seriously question whether you need these compounds in your facility. These include peroxidizable solvents, potentially explosive dinitro- and trinitro- organic compounds and elemental potassium.

Metal Azides

Inorganic azide compounds, such as sodium azide, can react with metals and their salts to produce explosive metal azide crystals. For example, when azide solutions are poured down drains the dilute solution can react with lead solder and copper pipes to produce explosive lead or copper azide salts.

- If you must use azide solutions, replace metal pipes with PVC or other non-metal piping materials.
- If sodium azide solutions have been discharged to drains having metallic pipes or solder, you should assume your pipes may be contaminated with metal azide salts. Contact the Business Waste Line at 206-296-3976 or Washington Department of Ecology (Ecology) at 425-649-7000 for assistance in determining the proper disposal procedures.

Ethers and Other Peroxide-forming Chemicals

Certain ethers are more susceptible to peroxide formation than others. Peroxides are formed by oxygen that reacts with ethers: R-O-R is ether; R-O-O-R is peroxide. It is the oxygen-to-oxygen bond that makes ether unstable. Generally, the larger the alkyl group (R), the more readily the ether will form peroxides. Ethyl ether and isopropyl ether can react with air to form explosive peroxide crystals. Other solvents such as tetrahydrofuran and dioxane can also produce peroxides.

Peroxides can explode when subjected to heat, friction or shock. Do not disturb or open containers in which peroxides may have formed. A good rule of thumb is to dispose of any container holding a peroxide-forming compound one year after the date it was opened. Label these containers with the words "DATE OPENED" and add the date.

To prevent the formation of peroxides:

- Avoid using peroxide-forming solvents if possible.
- Purchase ether with butylhydroxy toluene (BHT) or ethanol added as an anti-oxidant.
- Label ether containers with the dates they are opened.
- Purchase ether in containers small enough to use all the solvent within six months.
- Check the MSDSs for your solvents to see if any are prone to creating peroxides.

Elemental potassium is a peroxide-former that is commonly used in school laboratories to demonstrate characteristics of period 1 earth metals. Potassium is a water-reactive earth metal that reacts with moisture in air to start the peroxidation process. This process can be observed by physical changes in the color of the potassium sticks. Originally a dull silver color, potassium will oxidize and form white crystals on its surface. As these crystals progressively turn yellow, orange, red and purple, the peroxidation process is advancing and the compound is increasingly at risk of exploding when handled. [Blair, 2000]

Metal Picrates and Picric Acid

Metal picrate compounds and picric acid can become dangerously unstable as a dry powder. Picric acid can dry out and form explosive picrate crystals when exposed to air, especially when contaminated with even minute amounts of metals.

To prevent the formation of explosive picrate crystals:

- Always keep picric acid wet or in solution.
- Avoid contact between picric acid and metals. Metal picrate salts are prone to explode when subjected to friction or shock.
- Never purchase or store picric acid in containers with metal lids.
- Avoid flushing picric acid solutions down drains at concentrations above 0.01 percent.

- Dispose of more concentrated picric acid solutions as dangerous waste.
- Bouin's Fixative contains picric acid and formaldehyde solution (formalin.) Be sure to keep this fixative hydrated with water. Bouin's 2000 is a picric acid and formalin-free alternative available from American Master*Tech Scientific, Inc. 800-860-4073.
- If picric acid solutions have been discharged to drains with metallic pipes or soldered joints, assume the piping is contaminated with explosive metal picrate salts. Contact the Business Waste Line at 206-296-3976 or Ecology at 425-649-7000 for help in finding proper disposal procedures.

Perchloric Acid

Perchloric acid is highly corrosive and typically occurs as a 70 percent solution. When warmed above 150 degrees Fahrenheit, it is a powerful oxidizer. Perchloric acid can form explosive metal perchlorate crystals in combination with heavy metals. Any work with perchloric acid must be done in a specially-designed fume hood with a water wash down system designed to prevent the buildup of metal perchlorates in the duct work. If you have been performing perchloric acid digestions in a fume hood not specifically designed for perchloric acid, contact the Business Waste Line at 206-296-3976 or Ecology at 425-649-7000 immediately for assistance in locating a contractor to evaluate the hood for perchlorate contamination.

- **Spills and other emergencies:** In the event of a perchloric acid spill, neutralize with soda ash (sodium carbonate) or another appropriate neutralizing agent. Soak up the spill with an inorganic based absorbent. Do NOT use rags, paper towels, or sawdust and then put them aside to dry out, as such materials may spontaneously ignite. Likewise, spills on wood may present a fire hazard after the liquid dries.
- If you must use perchloric acid solutions, replace metal pipes with PVC or other non-metal piping materials.
- If perchloric acid solutions have been discharged to drains having metallic pipes or solder, you should assume that your pipes may be contaminated with metal azide salts. Contact the Business Waste Line at 206-296-3976 or Ecology at 425-649-7000 for assistance in determining the proper disposal procedures.
- Regularly inspect your containers of perchloric acid for discoloration. If the acid has turned a dark color and has crystals forming around the bottom of the bottle, there is a potential explosion hazard. Notify an emergency response agency and secure the area. White crystals around the cap are typically an ammonium salt, and small amounts may be washed off the bottle to the sewer using copious amounts of water.

Ammoniacal Silver Staining Solutions

Ammoniacal silver staining solutions are hazardous because they can form explosive silver salts. Whether disposed or deactivated, these wastes are counted against your generator status. See *Appendix C* for information on these and other stains.

Safe use of these staining solutions includes the following procedures:

- Don't allow silver nitrate to remain in ammonium solutions for more than two hours.
- Keep silver nitrate solutions separate from ammonium hydroxide solutions.
- Deactivate these waste solutions by diluting 15:1 with water. Then, while stirring frequently, slowly add 5 percent hydrochloric acid to the solution until the pH reaches 2.
- Add ice if the solution heats up.
- Silver chloride will precipitate out when the pH reaches 2.
- Filter out the precipitate and dispose as hazardous waste, adjust the pH of the solution to 6 to 7 with sodium bicarbonate, then discharge to the sanitary sewer.

HAZARDOUS WASTE REDUCTION AND DISPOSAL

A hazardous waste is a solid, liquid or gas that could pose dangers to human health or the environment. In Washington State, hazardous waste is called dangerous waste and is primarily regulated by the Department of Ecology (Ecology). Several other federal, state and local agencies may regulate a laboratory's hazardous materials and wastes. These include the federal Environmental Protection Agency, the state Department of Labor and Industries, the local fire department, the local air quality authority and the local sewer district.

Not complying with hazardous waste regulations can lead to significant fines and penalties. It is important that laboratory managers take steps to avoid violating regulatory requirements.

- The manager of a laboratory should establish, follow and support a laboratory waste management policy.
- The policy should include written procedures and defined responsibilities.
- Laboratories should have a staff member responsible for coordinating hazardous materials management and ensuring regulatory compliance.

The Occupational Health and Safety Administration (OSHA) requires all laboratories to implement a written Chemical Hygiene Plan. These plans are monitored for compliance with OSHA requirements by the state Department of Labor and Industries. In 29 CFR Part 1910 § 191.1450, Appendix A, OSHA lists the National Research Council's recommendations concerning chemical hygiene in laboratories. Important topics that should be addressed include rules and procedures about:

- Chemical procurement, distribution and storage
- Environmental monitoring
- Housekeeping, maintenance and inspections
- Medical program
- Personal protective apparel and equipment
- Records
- Signs and labels
- Training and information
- Waste disposal

OSHA recommends that a laboratory's Chemical Hygiene Plan include a waste disposal program. The following are specific recommendations (29 CFR 1910 §191.1450):

- Comply with Department of Transportation regulations (CFR 49) when transporting wastes.

- Promptly dispose of unlabeled containers. If partially used, they should not be opened.
- Remove waste from laboratories to a central waste storage area at least once a week and from the central waste storage area at regular intervals.
- Avoid indiscriminate disposal by pouring waste chemicals down the drain or adding them to mixed refuse for landfill burial. This is unacceptable and often illegal.
- Do not use fume hoods to dispose of volatile chemicals.
- Dispose of wastes by recycling, reclamation or chemical deactivation whenever possible.
- Avoid stocking over 2.2 pounds or 1.0 kilograms of "P-listed" chemical products (WAC 173-303-9903.) This could help you stay below large quantity hazardous waste generator status.
- Limit the size of samples you accept and guarantee your ability to return samples to the supplier.

Hazardous waste disposal is a complex issue. Before you attempt to deactivate hazardous wastes for sewer or solid waste disposal, check with the regulating agency to see if the process is acceptable. Written documentation of chemical deactivation activities may be required. Several resources are available to provide guidance in managing your laboratory wastes. The following sections provide guidance on specific waste streams that labs often find challenging to properly manage.

Acetone Used in Glassware Cleaning

Analytical laboratories often use acetone when cleaning glassware. Acetone is ignitable and is a federally-regulated F003 dangerous waste. It may not be rinsed off the glassware and put down the drain. (Flammable liquids are prohibited from sewer disposal.) Instead, collect acetone rinsate and dispose of it as ignitable dangerous waste.

High Pressure Liquid Chromatography Waste

High pressure liquid chromatography (HPLC) analyses are typically done with a mixture of water, acetonitrile and methanol. Both acetonitrile and methanol are flammable solvents. Some methods add 0.1 percent trifluoroacetic acid to the mixture. Acetonitrile concentrations in the resulting liquid waste range from 10 to 40 percent and are prohibited from discharge to the sewer.

There are a number of ways to reduce the volume of solvent waste from HPLC analyses. These include modifying the size of columns used in the process, distilling and reusing acetonitrile, and separating water from the solvent waste. If the water remaining after separation contains <100 milligrams/liter of acetonitrile, it may be discharged to the sewer in King County.

Ethidium Bromide Management

Ethidium bromide (EtBr) is commonly used in molecular biology research and teaching laboratories. While it is not regulated as dangerous waste, the mutagenic properties of this substance may present a hazard when poured down the drain or placed in the trash.

Based on these considerations, the following disposal procedures for ethidium bromide are recommended:

Disposal of Pure Ethidium Bromide

Unused Ethidium Bromide (EtBr) should be collected for disposal with a hazardous waste vendor.

Disposal of Electrophoresis Gels

Trace amounts of EtBr in electrophoresis gels should not pose a hazard. Higher concentrations, e.g., when the color of the gel is dark pink or red, should not be placed in laboratory trash. The disposal recommendations for gels are:

- Less than 0.1% EtBr: dispose as solid waste with approval from Public Health – Seattle & King County
- More than or equal to 0.1% EtBr: place in sealed bags and label for disposal as hazardous waste.

Disposal of Contaminated Gloves, Equipment and Debris

Gloves, test tubes, paper towels, etc., that are contaminated with more than trace amounts of EtBr should be placed in sealed bags and labeled for hazardous waste disposal.

Disposal of Ethidium Bromide Solutions

Aqueous solutions with <10µg/ml (<10 ppm) EtBr can be discharged to the sewer.

Aqueous solutions containing >10µg/ml (>10 ppm) EtBr: Chemically treat using the decontamination procedures listed below and dispose to the sewer or collect for disposal as dangerous waste. All aqueous solutions released to the sewer must meet local sewer discharge requirements for metals, pH, etc.

Solvent solutions containing any amount of EtBr; or EtBr mixed with a radioactive isotope are restricted from discharge to the sewer and should be disposed as ignitable dangerous waste.

Treatment of Ethidium Bromide Waste

Ethidium bromide waste solutions can be treated to increase their concentration before disposal, thereby reducing disposal costs, or deactivated to eliminate their hazardous characteristics before discharge to the sewer. Most universities recommend filtration over deactivation as the safer method.

Filtering aqueous EtBr waste solutions through activated charcoal is simple and effective. The filtrate may be poured down the drain. Commercially available filtration systems include FluorAway™, the S&S Extractor™ and The Green Bag® Kit.

- Filter the EtBr solution through charcoal filter.
- Pour filtrate down the drain.
- Place charcoal filter in a sealed bag (e.g., zip-lock) and collect for disposal as hazardous waste.

A safety note: if using house vacuum to speed filtration, do not use a standard Erlenmeyer or side-arm filtering flask. A filtration flask capable of withstanding vacuum must be used to prevent implosion.

Deactivating EtBr Solutions

All EtBr solutions that are deactivated should be neutralized and poured down the drain with copious amounts of water. Deactivation may be confirmed using ultraviolet (UV) light to detect fluorescence. There are two recognized methods for deactivation, the Lunn and Sansone Method [Lunn and Sansone, 1994, p. 185] using hypophosphorus acid and sodium nitrate, and the Armour Method that uses household bleach. [Armour, 1996, p. 214] Though the Armour Method is the simplest, it is somewhat controversial since found traces of mutagenic reaction mixtures using this method. [Lunn and Sansone, *Analytical Biochemistry,* 1987, vol. 162, p. 453]

Decontamination of Ethidium Bromide Spills

EtBr spills can be decontaminated with a solution of 20 ml of hypophosphorus acid (50%) added to a solution of 4.2 g of sodium nitrate in 300 ml water. Prepare fresh solution the day of use in a fume hood. Wear rubber gloves, lab coat, and safety glasses. Turn off electrical equipment before decontamination.

- Soak paper towel in decontamination solution, place on contaminated surface, and scrub.
- Scrub five more times with paper towels soaked in water, using fresh towel each time.
- Place all towels in a container and soak in fresh decontamination solution for one hour.
- Test squeezings from final towel scrub and mixture for fluorescence; repeat procedure with fresh decontamination solution if fluorescence is present.
- Neutralize with sodium bicarbonate and discard as nonhazardous aqueous waste.
- This procedure has been validated for EtBr-contaminated stainless steel, Formica, glass, vinyl floor tile surfaces, and filters of transilluminators.

Alternatives to Ethidium Bromide

Ethidium bromide (EtBr) is a dangerous compound due to its mutagenicity. SYBR Safe™ is a potentially safer alternative. Data on mutagenicity and EcoToxicity show SYBR Safe™ is much less mutagenic than EtBr and is acceptable for discharge to the sanitary sewer.

Several major institutions have switched from EtBr to SYBR Safe™ with good results in DNA analysis. However, SYBR Safe™ is less effective than the traditional EtBr staining for RNA analysis.

Disposal of Alcohols

Alcohols, such as ethanol, methanol and isopropanol, are common organic solvents used in laboratories. All are flammable and are regulated as ignitable hazardous waste at concentrations above 24 percent in water. Additionally, methanol and isopropanol are category D toxic hazardous wastes under the Washington Dangerous Waste Regulations and are considered hazardous waste at a concentration above 10 percent in water.

Alcohol solutions that characterize as hazardous wastes are prohibited from discharge to the sewer. Dilution of waste alcohol **solely** to bring its concentration below these levels is prohibited. Dilution of alcohol that is done **as part of the "industrial process"** at the lab is allowed and its concentration is not evaluated for waste characterization until the process is complete.

For example, in teaching laboratories, what would be considered "waste" ethanol can be mixed with water to demonstrate the Particle Theory. The final volume of the solution is less than the predicted sum of the volumes of the separate solutions because the alcohol and water molecules arrange in a different geometry that is more closely packed. At the point the demonstration is completed, the ethanol concentration is determined. If the final ethanol concentration is below 24 percent, it will not be considered an ignitable waste and would be acceptable for discharge to the sewer.

Technologies are available for removing stains, dyes and cell debris from reagent grade ethanol, methanol and isopropanol used in Cytology and Histology stain lines, thus permitting the same alcohol to be reused indefinitely. In addition, these systems will remove lipids (fats) and marker inks commonly found in tissue processor waste alcohol. Commercially available systems include the filtration-based Benchtop Alcohol Recycling System™ from Creative Waste Solutions and fractional-distillation-based systems from B/R Instruments, CBG Biotech and CMT Environmental Services. Suncycle Systems has also developed an alcohol cartridge recycling system for tissue processors.

Descriptions of these systems can be found by visiting the Sustainable Hospitals website at http://www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Cat&id=30

Isopropanol is often used as a disinfectant in medical labs. Surfaces are wiped down with a cloth or paper towel holding isopropanol, with much of the isopropanol evaporating off the cloth and counter. When the cloth wiper is no longer useful, put the rag in your shop towel collection container for laundering, or wring out the free liquids into an ignitable hazardous

waste collection container. The remaining cloth or paper wiper will typically be acceptable for disposal as solid waste. See *Appendix E, Solid Waste Disposal – Common Questions,* for important information on receiving clearance for disposal of solid waste in King County.

Disposal of 3,3-Diaminobenzidine (DAB)

3,3-Diaminobenzidine lacks toxicity data to allow characterization as a dangerous waste. It is a potent mutagen and should be handled very carefully. Contact with the skin causes burning pain and itching. Inhalation can cause cyanosis (bluish lips.) Because it poses a serious risk to health on contact, DAB is not permitted to be discharged to the sewer or septic tank. It is recommended that DAB be disposed as a hazardous waste or be detoxified prior to discharge to the sewer.

Do not try to detoxify DAB with chlorine bleach (sodium hypochlorite) because the products remain toxic. There are two methods to detoxify DAB. One method is described as follows: [Dapson, 1995, p. 162]

DAB Detoxification Procedure

1. Prepare the following aqueous stock solutions

    - 0.2 M potassium permanganate (31.6 g $KMnO_4$ /liter)
    - 2.0 M sulfuric acid (112 ml concentrated acid/liter)

2. Dilute the DAB solution until its concentration does not exceed 0.9 mg/ml.

3. For each 10 ml of DAB solution, add:

    - 5 ml 0.2 M potassium permanganate
    - 5 ml 2.0 M sulfuric acid

4. Allow mixture to stand for at least 10 hours. It is now non-mutagenic.

Disposal of Wastes Containing Sodium Azide

Some commonly used laboratory reagents contain sodium azide. Sodium azide is a category-B toxic compound due to oral-rat LD50 data, so in a mixture it will designate at a concentration of 0.1%. Any waste containing over 0.1% sodium azide must either be treated to remove the toxicity characteristic or disposed as a hazardous waste. It also can form explosive metal azides, as is discussed in the *Managing Hazardous Chemicals On-site* section below.

Enterococcus Agar

Here is a common list of constituents and concentrations, expressed in amount per liter.

Enzymatic Digest of Casein ..... 13.0 g

Enzymatic Digest of Soybean Meal ..... 5.0 g

Yeast Extract ..... 6.0 g

Dextrose..... 3.0 g

Dipotassium Phosphate ..... 4.0 g

Sodium Azide ..... 0.4 g

Agar ..... 10.0 g

Through this calculation: 0.4 grams/liter = 400 mg/L = 400 ppm = 0.04%, we find the final sodium azide concentration to be below the 0.1% concentration where it would designate as a hazardous waste. Therefore, waste *Enterococcus* agars do not have to be counted or disposed as hazardous waste.

Alkaline Iodide Azide (AIA) Reagent for the Winkler Dissolved Oxygen Titration

Here is a common list of constituents and concentrations in the AIA reagent before being added to a water sample for dissolved oxygen analysis.

Water ..... 50.0 percent

Potassium Hydroxide..... 40.0 percent

Potassium Iodide ..... 9.0 percent

Sodium Azide ..... 0.6 percent

Since the sodium azide concentration is over 0.1% with a pH greater than 12.5, expired or unused stock reagent will be regulated as a corrosive, Washington-state-only toxic hazardous waste. When used as a titrant, it is sufficiently diluted during the analytical process to fall below the 0.1% concentration limit. The waste solution generated by the Winkler Method must be counted as a corrosive hazardous waste if its final pH is over 12.5, but it can then be neutralized under the treatment-by-generator guidelines and disposed to the sewer.

Management of Aldehyde Wastes

The most common aldehyde wastes coming from labs are ten-percent buffered formalin (3.7 percent formaldehyde solution,) two-to-four percent glutaraldehyde solutions and 0.5 percent ortho-phthalaldehyde (OPA) solutions (typically Cidex® OPA.) Formalin is used as a tissue preservative. Ortho-phthalaldehyde and glutaraldehyde are used as cold sterilants.

Formalin

Formaldehyde solutions are regulated in Washington State as category C toxic compounds. Based on equivalent concentration criteria, formaldehyde solutions designate as hazardous wastes at concentrations of 1.0 percent or more in water. However, due to concerns about worker exposure to formaldehyde vapors, the discharge limit to the King County sewer

system is 0.1 percent formaldehyde in water. Formaldehyde solutions can never go into septic systems or storm drains. Solutions that are more than 1.0 percent formaldehyde must either be disposed as hazardous waste or chemically treated to reduce the formaldehyde concentration to acceptable levels for sewer discharge.

Chemical Treatment of Formalin

Formalin is readily treatable. Solutions should be diluted with water to fewer than five percent formaldehyde before chemical treatment. Commercially available chemical treatment products that will "detoxify" formalin are listed below (although this list may not be exhaustive):

- "Neutralex™" - produced by Scigen/Tissue Tek 800-725-8723 ext. 7268 (certified as a treatment technology in California)
- VYTAC™ 10F" - by Baxter Healthcare Corp 800-964-5227 (certified as a treatment technology in California)
- "Aldex®" – by Waste & Compliance Management, Inc. 866-436-9264 (turns the formalin into a solid for disposal as solid waste)
- "Formalex®" - by S&S SASCO 800-624-8021 (notes: requires filtering and may require pH adjustment; decertified as a treatment technology in California)
- "D-Formalizer®" - by Surgipath 800-225-3035 (not recommended due to release of low levels of hydrogen sulfide gas)
- "Trans*Form™" – by American Master*Tech Scientific 800-860-4073.

Note that California's treatment technology certification program is no longer funded at the time this edition was written.

According to product data, these compounds will reduce the concentration of a treated sample of formalin to under 0.1 percent formaldehyde, though the times required for this vary. According to product literature, both "Neutralex™" and "D-Formalizer®" will reduce the concentration to less than 25 parts per million (ppm) in 15 minutes.

Since the sewer limit is 0.1 percent residual formaldehyde, the treatment compounds can be diluted below the manufacturer's recommended concentration. For Neutralex™, one packet is described as treating one gallon of buffered formalin to 15 ppm. However, since the sewer limit is 1000 ppm, the packet can actually treat 50 times as much formalin and still have the resulting solution meet the local sewer limit.

Formalin treatment is covered under the treatment by generator guidelines, so log sheets must be kept indicating the amount of formalin treated and the dates the treatment occurred. The amount of formalin generated before treatment must continue to be counted toward your generator status.

Alternatives to Formalin

Another option is to request less hazardous preservatives from suppliers. Safer substitutes for formaldehyde can reduce the risk of harmful exposures and potentially eliminate disposal problems. Be sure to check with the Business Waste Line at 206-296-3976 before purchasing a "safer substitute" to ensure that it really is less hazardous.

Propylene glycol-based solutions are often used for soaking solutions on specimens that have been preserved in formalin. In histology settings, Prefer® or Safe-Fix® have been used as effective substitute preservatives to formalin on small specimens but have been found to be less effective on larger tissues due to their slower penetration rate. Other formalin alternatives include ExCell Plus™ and Optimal*Fix™

Glutaraldehyde

Glutaraldehyde solutions are regulated in Washington State as category C toxic compounds. Based on equivalent concentration criteria, glutaraldehyde solutions designate as hazardous wastes at concentrations of 1.0 percent in water. However, research on biodegradability tests found that two-to-four percent glutaraldehyde sterilant solutions broke down readily to non-hazardous by-products in the sewer system. [Balogh, 1997] Therefore, cold sterilant solutions containing less than four percent glutaraldehyde are acceptable for discharge to the King County sewer system. Glutaraldehyde solutions can never go into septic systems or storm drains. Solutions of over 4.0 percent glutaraldehyde must either be disposed as hazardous waste or chemically treated to reduce the glutaraldehyde concentration to acceptable levels for sewer discharge.

Chemical Treatment of Glutaraldehyde

Glutaraldehyde is readily treatable using the same methods described above for formalin. Dilute solutions with water to less than five percent glutaraldehyde prior to chemical treatment.

Ortho-Phthalaldehyde

O-phthalaldehyde solutions are regulated in Washington State as category C toxic compounds. Based on equivalent concentration criteria, o-phthalaldehyde solutions designate as hazardous wastes at concentrations of 1.0 percent in water. Therefore, cold sterilant solutions containing less than one percent o-phthalaldehyde are acceptable for discharge to the King County sewer system. O-phthalaldehyde solutions can never go into septic systems or storm drains.

One of the most commonly used o-phthalaldehyde-based cold sterilants is Cidex® OPA. Cidex® OPA contains 0.55 percent o-phthalaldehyde and therefore is acceptable for discharge to the sewer at its working strength.

Research has recently been done on the aquatic toxicity of o-phthalaldehyde. Preliminary data indicates that o-phthalaldehyde may be highly toxic to fish, which could lead to it being prohibited from discharge to the sewer untreated.

Chemical Treatment of Ortho-Phthalaldehyde

O-phthalaldehyde is readily treatable by adding the amino acid glycine to it at a rate of 25 grams per gallon of waste o-phthalaldehyde. Treating spent o-phthalaldehyde-based solutions with glycine prior to discharge to the sewer is currently recommended as a best management practice by the Washington Department of Ecology. [Fernandes, 2005]

Aldehyde Spill Management

Glutaraldehyde and formalin spills can be deactivated with one of the commercially-available treatment chemicals listed above. O-phthalaldehyde spills can be deactivated by adding 25 grams of the amino acid glycine to each gallon of spilled material.

Management of Scintillation Fluid Wastes

Scintillation fluids are used to detect weak alpha and beta-emitting radionuclides. This is typically done by mixing the fluid with the radionuclide, which contaminates the fluid.

If the stock fluid contains hazardous materials, the waste produced is by definition mixed waste (both hazardous and low-level radioactive waste.) If the radioactive material concentration is sufficiently low, the fluid can be disposed as a hazardous waste.

In guidance published between 1993 and 1995, the Department of Ecology approved three scintillation fluids for discharge to the sewer:

- Packard / Perkin Elmer (PE) Microscint™ O
- Packard / PE Optifluor™
- National Diagnostic's Ecoscint

At this time, no other products have been approved by Ecology for discharge to the sewer. Generally, if the samples turn out to be radioactive, they are disposed as either a mixed waste or a radioactive waste. Those samples which do not have radioactivity detected (or very low amounts of radioactivity) would be disposed in the sewer if non-hazardous or disposed as a chemical waste or mixed waste if toxic.

Many other products are in the market. The compounds listed below designate as dangerous waste and are prohibited from discharge to the sewer. The surfactants in many scintillation cocktails contain alkyl phenoxy ethoxylates (APEs) or tergitol. Both of these compounds are Category D toxic hazardous wastes. Other cocktails contain xylene, pseudocumene or other solvents that cause them to be regulated as ignitable hazardous wastes.

- Packard / Perkin Elmer: *Microscint™ 20, Ultima Gold, OptiPhase HiSafe, OptiPhase HiSafe 2* and *OptiPhase PolySafe*
- National Diagnostics: *Ecoscint™ A, Ecoscint™ O* and *Ecoscint™ H, Uniscint BD*
- Beckman Coulter: *Ready Safe, Ready Protein+, Ready Gel, Ready Value, Ready Organic, Ready Flow III* and *Ready Solv HP*

Pollution Prevention (P2)

Activities that reduce waste and prevent pollution are strongly encouraged by Ecology, King County Water and Land Resources Division and the Local Hazardous Waste Management Program in King County. Reducing use of chemicals reduces chemical waste. Basic pollution prevention techniques include product substitution, reduced product usage, recycling and reuse of chemicals, modified operations, careful inventory tracking and water conservation.

Pollution prevention best management practices include the following:

- Use analytical methods that do not require hazardous chemicals.
- Substitute hazardous chemicals with less toxic alternatives.
- Use the least amount of chemical required for each experiment or process so that there is less to dispose of as waste.
- Ask if your suppliers offer chemicals in small volumes and buy them in small lots. This can reduce waste and leftover materials in case procedures are changed, expiration dates pass or spills occur.
- Use microscale techniques when available to reduce analytical wastes. Contact the National Microscale Chemistry Center for more information and assistance.
- Microscale chemistry often is too expensive for high school and middle school laboratories. Small-scale chemistry is a less expensive alternative that has been adopted by many schools. Stock solution concentrations are typically reduced to less than 1.0 molar, volumes are measured in drops rather than milliliters and inexpensive plastic equipment is used rather than expensive glassware. Contact the National Small Scale Chemistry Center for more information and assistance.
- Date containers when they arrive so you can see how quickly they are used (if at all). Bar coding systems are now available to track inventory.
- Consolidate or coordinate purchasing authority to reduce duplicate purchases of chemicals and improve inventory tracking.
- Check with suppliers of your laboratory standards. Some will allow you to ship standards back for reuse after the expiration dates have passed. If yours does not, dispose of them properly.

P2 Example: Liquid Chromatography

Solvent recycling in liquid chromatography (LC and HPLC) can be done by the microprocessor controlled S^3 Solvent Saver System®. It uses a sensitive level sensing circuit to shunt the eluant to waste whenever the output from the system detector exceeds a user set level. After the contaminant (normally a component from the sample) has passed and the output from the system detector drops below the programmed level, the uncontaminated

solvent will be returned to the solvent reservoir to be used again, reducing both solvent disposal and purchasing costs.

P2 Example: Western Blotting

Western blotting is a technique used by biochemists to electrophoretically transfer proteins from polyacrylamide gels onto a more stable membrane substrate, such as nitrocellulose. The standard conducting solution used during western blotting contains 20% methanol, resulting in the generation of a listed hazardous waste. For many protein transfer applications, particularly those involving high molecular weight proteins, it is possible, and even helpful, to replace 20% methanol, a hazardous waste, with 20% ethanol, a non-hazardous waste, in the conducting solution.

On-site Treatment of Laboratory Wastes

Laboratories are uniquely qualified to treat some of their wastes to eliminate their hazards or reduce the amount of waste needing disposal, thereby cutting costs. Unlike the situation in many other states, the Washington Department of Ecology encourages on-site treatment of hazardous wastes by generators. Six focus sheets have been published by Ecology to provide treatment-specific guidance on carbon adsorption, elementary neutralization, evaporation, filtration, separation and solidification. Ecology's Technical Information Memorandum 96-412 provides guidance on how to conduct these activities.

Specific Standards for On-site Treatment of Wastes

- Before initiating treatment, verify the resulting wastes are acceptable for disposal as solid waste or to the sewer and that the treatment process cannot pose a risk to human health or the environment.
- The container in which treatment occurs must be marked with the date was first accumulated in it and emptied every 180 days for medium quantity generators or 90 days for large quantity generators.
- The containers must be in good condition, compatible with their contents, properly labeled, kept closed and inspected weekly.
- Secondary containment should be provided for wastes awaiting treatment.

The following criteria are condensed from Ecology's Treatment by Generator (TBG) Fact Sheets. [Ecology, 2004]

Carbon Adsorption

- It works well with aromatic solvents, chlorinated organics, phenols, polynuclear aromatics, organic pesticides, chlorinated non-aromatics, high molecular weight aliphatics, chlorine, halogens, antimony, arsenic, bismuth, chromium, tin, silver, mercury and cobalt.

- It works poorly with alcohols, low molecular weight ketones, organic acids, aldehydes, low molecular weight aliphatics, nitrates, phosphates, chlorides, bromides, iodides, lead, nickel, copper, cadmium, zinc, barium and selenium.

- It is allowed when treated effluent and backwash are properly managed and disposed, spent carbon is regenerated or disposed properly, spills and releases are promptly cleaned, equipment is decontaminated as needed and sufficient time is provided for the carbon to adsorb contaminants.

Evaporation

- It is allowed if only inorganic waste mixed with water is treated, all organic vapors from organic solutions are captured, some water content is left to prevent "over-cooking" of sludges, remaining sludges are properly disposed and secondary containment is provided for the evaporator.

- Many schools can evaporate water from waste copper sulfate and other metal solutions as a waste-reduction and cost-cutting technique. By lining the evaporation container with a closable plastic bag, the waste sludge can be easily removed and placed in a small hazardous waste collection container for eventual removal.

Separation

- All separation processes must not change a waste's structure, except to form a precipitate, and cannot generate toxic or flammable gases unless all vapors are captured.

Elementary Neutralization

- This process can only be used on wastes that are regulated solely because they exhibit the characteristic of corrosivity from having a pH of less than or equal to 2.0 or greater than or equal to 12.5.

- The resulting waste must have a pH between 6 and 9 and meet the sewer discharge guidelines listed in Appendix A prior to discharge

- Neutralizing large volumes of concentrated mineral acids is discouraged, since it generates significant heat and fumes which pose serious safety risks.

- Passive limestone acid-neutralization tanks are not recommended. These tanks are hard to maintain, sulfuric acid can significantly reduce their effectiveness and hard-to-reach sediments must be removed and characterized before disposal.

Treatment by Generator Counting Requirements

- Regulated generators must notify Ecology on their Form 2 and in their Dangerous Waste Annual Report that they are conducting treatment by generator activities and whether it is being done in accordance with a specific fact sheet. This notification must occur before initiating treatment.

- TBG activities will not reduce a lab's hazardous waste generator status, but it will typically reduce disposal costs significantly. For annual reporting and generator status determinations, the total quantity (as wet weight) of waste generated prior to treatment and the weight of any remaining material that designates as hazardous waste after treatment must be counted. The waste before treatment and materials remaining after the process must be designated and managed properly.

- Generators must maintain a written log of the quantity of each dangerous waste managed on site, the treatment method and the date treatment occurred.

Permit by Rule

Permit by rule is a second regulatory allowance for on-site treatment of wastes before disposal. One of the common areas of regulatory confusion regards the difference between permit by rule and treatment by generator. Both are available options for laboratories wishing to manage wastes on site.

There are two primary benefits derived from receiving a permit or written authorization that qualifies a process for permit-by-rule exemption.

- The waste that is treated under Permit by Rule is exempt from being counted toward your generator status.

- Waste disposal costs are less because your waste is not hauled off-site

Conditions to Qualify for Permit by Rule (PBR) Exemption

- You must have written permission to discharge the waste to the sewer from the Publicly Owned Treatment Works (POTW.) **NOTE**: This document does not constitute permission under the PBR guidance in WAC 173-303-802.

- Wastes must be properly designated at point of generation, before mixing with any other waste streams.

- If treatment will be in an elementary neutralization unit, wastes must designate as hazardous only because of the corrosivity characteristic.

- In order to qualify as an elementary neutralization unit, treatment must take place in a tank or container.

- The waste must be treated immediately upon being generated. This requires a "hard-piped" system connecting the process that generated the waste to the treatment tank. There

can be no break between the point where the waste was generated and the treatment tank, such as by emptying the waste into a bucket and then pouring it into the treatment tank.

- The generator must notify Ecology that wastes are being treated on-site and indicate on the annual report that PBR activity is being conducted.
- The facility must have a contingency plan and emergency procedures.
- Weekly inspections of the treatment tank's integrity must be done and good housekeeping practiced in the area.
- Staff training must be documented.

Example: PBR for Lab Sample Destruction

- You must meet all the requirements listed above under **Conditions to Qualify for Permit by Rule (PBR) Exemption**. **NOTE**: This document does not constitute permission under the PBR guidance in WAC 173-303-802.
- Laboratory samples are kept under chain-of-custody protocols for an established length of time before being disposed. Some of these samples are of water which has been acidified before analysis to preserve the sample.
- When the protocol no longer requires a sample be stored, it can be disposed. If the sample is hazardous only for the corrosivity characteristic, it can be neutralized and discharged to the sewer. This neutralization can be viewed as treatment by generator or permit by rule depending on the circumstances.
- When treated in batches by adding a neutralizing solution to the sample, it is considered treatment by generator (TBG) and the waste must be counted towards the lab's generator status. This is because the sample becomes a waste as soon as it begins to be treated and the treatment is done in a batch process. For larger labs doing water quality analyses, this could move their generator status up to large quantity generator.
- It is considered immediate treatment under PBR if an entire acidified liquid sample is poured or siphoned directly into a neutralization tank that already contains a basic neutralizing solution. This is considered PBR, and does not count as generated hazardous waste, because the liquid is a viable reference sample until it comes into contact with the neutralizing liquid via a continuous "hard-piped" system.

Example: PBR for Managing Acidic Glass-Washing Solutions

- You must meet all the general requirements listed above to qualify for PBR consideration. **NOTE**: This document does not constitute permission under the PBR guidance in WAC 173-303-802.
- Laboratory glassware is often acid-washed in tubs. This acidic wastewater must be neutralized before discharge to the drain. It is subject to regulation as dangerous waste if its pH is less than 2.0.

- This wastestream, which can also be a significant portion of a lab's entire generated waste, can be viewed as treatment by generator or permit by rule depending on the circumstances.
- If the wastewater from the glass washing tub is directly piped to an elementary neutralization tank, neutralized, then directly piped to the sewer, it will qualify as immediate treatment under PBR and not be counted as generated waste.
- If the glass washing wastewater is treated in batches by adding a neutralizing compound to it, the process is considered TBG and counts towards the lab's generated hazardous waste.

Wastewater and Solid Waste Disposal Guidelines

All wastewater discharged to the sewer system must comply with local, state and federal standards. These are designed to protect surface waters and to maintain the quality of biosolids from wastewater treatment plants. Discharge to a septic tank system is regulated as if the discharge was directly to groundwater, so virtually no wastes may go to a septic tank. Do not discharge laboratory wastes to a septic system. Laboratory operations often generate hazardous wastes that contain dilutions and mixtures of chemicals in very low concentrations or in small quantities. See Appendix A for King County guidelines for disposal of non-hazardous wastes to the sewer system.

Solid waste guidelines are designed to protect local and regional landfills, transfer stations, their customers and their employees. Appendix B lists King County guidelines for solid waste disposal. In general, each component of a waste stream must meet all criteria listed in the relevant appendix to be accepted for discharge to the King County sewer system or disposal as a solid waste.

The guidelines in the appendices are offered as a starting point for proper sewer and solid waste disposal and should not be considered definitive. Many aspects of the dangerous waste regulations, Chapter 173-303 WAC (listed wastes, off-spec chemicals, mixtures, formulations, etc.), are not covered in Appendices A and B. Please refer to WAC 173-303-070 through 173-303-110 for waste designation procedures. The generator has full responsibility for waste characterization and regulatory compliance.

Certain wastes that fail the criteria listed in Appendix A may be suitable for discharge to the sewer under special rules. Under all conditions, obtain written authorization from the King County Industrial Waste Program at 206-263-3000 or a local sewer utility to discharge wastewater that falls outside these criteria. For information on solid waste disposal, call the Waste Characterization Program at Public Health – Seattle & King County at 206-296-4633.

Again, these guidelines do not provide authorization under Permit by Rule to allow discharge of hazardous chemicals to the sewer. They serve, in part, as a guideline to assist businesses and agencies in King County in determining whether their waste may be acceptable for discharge to the sewer.

FOR MORE INFORMATION

Industrial Materials Exchanges

For materials management alternatives, contact the Industrial Materials Exchange (IMEX) at 206-296-4899. IMEX is a free service designed to help businesses find markets for industrial by-products and surplus materials. Through IMEX, businesses with materials they can no longer use can be matched with others who may need the materials. Materials are advertised at no cost.

Hazardous Waste Management--In King County

The Local Hazardous Waste Management Program in King County provides on-site consultation services to businesses in King County. The services are at no charge to the customer and do not have the regulatory authority of enforcement. Information is kept strictly confidential. Call 206-263-3080.

The Business Waste Line provides answers to questions about hazardous waste management. The caller may remain anonymous. Call 206-296-3976 or e-mail bwl@metrokc.gov

The Waste Characterization Program at Public Health – Seattle & King County provides answers about what can go into the landfills. Call 206-296-4633 or e-mail wc@metrokc.gov

Hazardous Waste Management-- Outside King County

The Northwest Regional Office of the Washington Department of Ecology provides technical and regulatory assistance to businesses throughout Washington State. In the northwest part of the state, they can be reached at 425-649-7000. Ask to speak to a hazardous waste technical assistance staff person.

King County Industrial Waste Program

For more information on sewer guidelines in King County, call the King County Industrial Waste Program at 206-263-3000 or your local sewer utility.

Air Quality Management

For more information on air quality guidelines in the Puget Sound region, call the Puget Sound Clean Air Agency at 206-343-8800.

Health and Safety Programs

For more information on health and safety regulations, call the Washington State Department of Labor and Industries, Voluntary Services Program at 206-281-5470. The Voluntary Services Program provides educational assistance to businesses at no charge and does not have the regulatory authority of enforcement. All information is kept strictly confidential.

Resources for Reducing the Scale of Experiments and Analyses

The National Microscale Chemistry Center offers workshops, seminars and publications on the operation and advantages of converting labs to the microscale level. Contact them via phone at 508-837-5137 or at their website at http://www.microscale.orgsilvertech.com/microscale/.

The National Small-Scale Chemistry Center is located at Colorado State University with regional centers across the United States. The focus of small-scale chemistry is the teaching lab. It is currently in use at secondary schools, community colleges and universities. Small scale differs from microscale in its use of inexpensive plastic materials in place of traditional glass apparatus. Both the volumes and concentrations of chemicals are reduced with these substantial benefits:

- Lower costs of materials and chemicals
- Increased safety from use of unbreakable plastic and nonhazardous solutions
- Reduced lab set-up and clean-up times, which allows more hands-on chemistry education

Visit their website at http://www.smallscalechemistry.colostate.edu/ for more information and a free video demonstrating the benefits of small-scale chemistry.

APPENDIX A

KING COUNTY GUIDELINES FOR SEWER DISPOSAL

King County Guidelines for Sewer Disposal		
Characteristic or Criteria	**Acceptable to sewer if meets ALL of these criteria**	**Unacceptable to sewer if exhibits ANY of these criteria**
1. Flash Point	>65 degrees C or 140 degrees F	<65 degrees C or 140 degrees F
2. Boiling Point	>65 degrees C or 140 degrees F	<65 degrees C or 140 degrees F
3. Corrosivity (pH)	5.5 to 12.0	<5.5 or >12.0
4. Solubility	Water soluble	Water insoluble
5. Reactivity	Non-reactive	Water or air reactive; explosive; polymerizer Creates toxic gas or nuisance stench
6. Radioactivity	Meets WA Dept. of Health limitations[1]	Does not meet Dept of Health limits[1]
7. Persistence (WAC 173-303-100)	Halogenated organic compounds <0.01% Polycyclic aromatic hydrocarbons <1.0%[2]	Halogenated organic compounds ≥0.01% PAH concentration ≥1.0%[2]
8. Toxicity (WAC 173-303-100)	Category X <0.001% Category A <0.01% Category B <0.1% Category C <1.0% Category D <10 % No evidence or Category E =100%	Category X ≥0.001% Category A ≥0.01% Category B ≥0.1% Category C ≥1.0% Category D ≥10%
9. Toxic Mixtures (WAC 173-303-100)	Equivalent concentration <0.001%[3]	Equivalent concentration ≥0.001%[3]

Important Note: These guidelines for sewer disposal are not definitive. Many aspects of Chapter 173-303 WAC (e.g., listed wastes, off-spec chemicals, mixtures, formulations, etc.) could not be covered in this table. Please refer to WAC 173-303-070 through -110 for waste designation procedures. These guidelines are offered as a starting point for proper sewer disposal. The discharger must take full responsibility for waste characterization and regulatory compliance. Certain wastes that fail the criteria listed in the above table may be suitable for discharge to the sewer under rules promulgated by the Washington State Department of Ecology. Under all conditions, obtain written authorization from King County's Industrial Waste Program to discharge wastewater that falls outside these criteria.

[1] Chapter 246 WAC. For specific guidance, contact the Washington Dept. of Health at 425-576-8945

[2] Polycyclic aromatic hydrocarbons (PAHs) include acenaphthene, acenaphthylene, fluorene, anthracene, fluoranthene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, pyrene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno (1,2,3-c,d)pyrene, benzo(g,h,l)perylene, dibenzo [(a,e), (a,h), (a,l), and (a,l)] pyrenes, and dibenzo (a,j) acridine. Also, carcinogens are not separately regulated.

[3] Small quantity generators of hazardous waste should contact their sewer agency to see if they are partially exempt from the Toxic Mixtures discharge requirements

Toxic Category Table (WAC 173-303-100)

Data can be found in the Registry of Toxic Effects of Chemical Substances (RTECS), NIOSH

Category	Fish LC_{50} (mg/L)	Oral (rat) LD_{50} (mg/kg)	Inhalation (rat) LC_{50} (mg/L)	Dermal (rabbit) LD_{50} (mg/kg)	Example Compounds
X	<0.01	<0.5	<0.02	<2	Organophosphate Insecticides
A	0.01 - <0.1	0.5 - <5.0	0.02 - <0.2	2 - <20	Fuming Nitric Acid, Aflatoxin
B	0. 1 - <1.0	5 - <50	0. 2 - <2.0	20 - <200	Phenol, Sodium Azide Sodium Cyanide
C	1.0 - <10	50 - <500	2.0 - <20	200 - <2000	Stannic Chloride, Sodium Fluoride
D	10 - 100	500 - 5000	20 - 200	2000 - 20,000	Methanol, Stannous Chloride

King County Local Sewer Limits[4]

Substance	Grab Sample Max (mg/L)	Daily Average Max (mg/L)[5]
Arsenic	4.0	1.0
Cadmium	0.6	0.5
Chromium	5.0	2.75
Copper	8.0	3.0
Cyanide	3.0	2.0
Lead	4.0	2.0
Mercury	0.2	0.1
Nickel	5.0	2.5
Silver	3.0	1.0
Zinc	10.0	5.0
Temperature	<150°F	----------
Hydrogen sulfide	10.0	----------
Polar fats, oil and grease (FOG)[6]	No visible FOG floating on surface	----------
Nonpolar FOG[6]	100	100

[4] **Important note**: Your sewer district may have local limits that are different than those listed above. Contact your local sewer district to learn their limits

[5] Daily average is calculated from three samples taken at least five minutes apart. Businesses discharging over 5,000 gallons a day must meet the standards for daily average maximum and grab sample maximum.

[6] Polar FOG is from animal or vegetable sources. Nonpolar FOG is from mineral or petroleum sources. **Important note**: Many sewer districts will have FOG limits that are lower than 100 mg/L. Contact your local sewer district to learn their limits and to verify whether their FOG limits are for Total FOG (polar + nonpolar) or for only nonpolar FOG.

Additional King County Sewer Guidelines	
Substance	**Discharge Limits[6]**
Glutaraldehyde[7]	One percent in water[7]
Formaldehyde	0.1 percent in water[8]
Formalin (treated)[9]	None once formaldehyde concentration is under limit and pH is adjusted as necessary
Ethanol	24 percent in water
Methanol	Ten percent in water
Isopropanol	Ten percent in water
Barium	100 mg/L
Beryllium	10 mg/L
Selenium	1.0 mg/L
Thallium	10 mg/L

[6] **Important note**: These guidelines are designed for small discharges of under 50 gallons. Your sewer district may have local limits that are different than those listed above. Contact your local sewer district to learn their limits

[7] Cold sterilant solutions containing no more than four percent glutaraldehyde may be discharged to the King County sewer provided appropriate BMPs are followed. Contact King County Industrial Waste for a copy of the "Policy regarding discharge of 2-4% glutaraldehyde disinfectant solutions to King County Sanitary Sewer".

[8] Formaldehyde is a category B toxic compound and therefore designates as a hazardous waste at concentrations above 0.1 percent.

[9] See section on formaldehyde treatment options.

APPENDIX B

SEATTLE & KING COUNTY GUIDELINES FOR SOLID WASTE DISPOSAL

Characteristic or Criteria	**Unacceptable** for solid waste disposal at sites in King County
1. Physical State	Liquid
2. Corrosivity (pH)	≤2.0 or ≥12.5
3. Reactivity	Water or air reactive; explosive; polymerizer. Creates toxic gas or nuisance stench
4. Radioactivity	Does not meet Dept of Health limits[1]
5. Toxicity Characteristic Leaching Procedure (WAC 173-303-090)	Must be less than Dangerous Waste limits for TCLP-listed metals and organics.
6. Persistence (WAC 173-303-100)	Halogenated organic compounds >0.01% PAH concentration >1.0%[2]
7. Toxicity (WAC 173-303-100)	Category X ≥0.001% Category A ≥0.01% Category B ≥0.1% Category C ≥1.0% Category D ≥10%
8. Formalin Preserved Tissues & Specimens	Residual formaldehyde concentration >1.0 %
9. Toxic Mixtures (WAC 173-303-100)	Equivalent concentration ≥0.001%

Important Note: These guidelines for solid waste disposal are not definitive. Many aspects of Chapter 173-303 WAC (e.g., listed wastes, off-spec chemicals, mixtures, formulations, etc.) could not be covered in this table. Please refer to WAC 173-303-070 through –110 for waste designation procedures. The guidelines provided here are offered as a starting point for proper solid waste disposal. The generator must take full responsibility for waste characterization and regulatory compliance. Under most conditions you should obtain a written clearance from Public Health Seattle & King County prior to disposal of contaminated or questionable solid waste. Call 206-296-4633 or e-mail wc@metrokc.gov for more help.

[1] Chapter 246 WAC. For specific guidance, contact the Washington Dept. of Health at 425-576-8945

[2] Polycyclic aromatic hydrocarbons (PAHs) include acenaphthene, acenaphthylene, fluorene, anthracene, fluoranthene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, pyrene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno (1,2,3-c,d)pyrene, benzo(g,h,l)perylene, dibenzo [(a,e), (a,h), (a,I), and (a,l)] pyrenes, and dibenzo (a,j) acridine. Carcinogens are not separately regulated.

Toxic Category Table (WAC 173-303-100) Data can be found in the Registry of Toxic Effects of Chemical Substances (RTECS), NIOSH					
Category	**Fish** **LC_{50} (mg/L)**	**Oral (rat)** **LD_{50} (mg/kg)**	**Inhalation (rat)** **LC_{50} (mg/L)**	**Dermal (rabbit)** **LD_{50} (mg/kg)**	**Example Compounds**
X	<0.01	<0.5	<0.02	<2	Organophosphate Insecticides
A	0.01 - <0.1	0.5 - <5.0	0.02 - <0.2	2 - <20	Mercuric chloride
B	0. 1 - <1.0	5 - <50	0. 2 - <2.0	20 - <200	Arsenic, Sodium Cyanide
C	1.0 - <10	50 - <500	2.0 - <20	200 - <2000	Phenol, Sodium Fluoride
D	10 - 100	500 - 5000	20 - 200	2000 - 20,000	Sodium Chloride, Stannous Chloride

APPENDIX C

PROPER DISPOSAL OF FIXATIVES & STAINS

Stain Solutions	Constituents	Disposal Option
Acid Fast Stain (for Mycobacteria)		
• Solution 1	Ethanol, basic fuchsin	Ignitable Hazardous Waste
• Solution 2	Organic cleaner	Not regulated as HW
• Working solution	Mix of solution 1 and 2	Ignitable HW
• Decolorizing solution	Ethanol, hydrochloric acid	Ignitable HW, check pH for corrosivity
• Methylene blue counterstain	Methylene blue, acetic acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
Alcian Blue Pas Stain		
• 1% Alcian blue solution	Alcian blue, acetic acid, thymol	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• 0.5% Periodic acid solution	Periodic acid	Test for oxidizer, otherwise not regulated as HW
• IN Hydrochloric acid	Hydrochloric acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• Shiff reagent	Basic fuchsin, sodium metabisulfate, IN hydrochloric acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• 0.55% Potassium metabisulfate solution	Potassium metabisulfate	Not regulated as HW
Alcian Blue Stain, pH 2.5		
• 3% Acetic acid solution	Acetic acid	Corrosive HW
• 1% Alcian blue solution	Alcian blue, acetic acid, thymol	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• Nuclear fast red counterstain solution	Nuclear fast red, aluminum sulfate	Not regulated as HW
Bluing Solution for Hematoxylin Stain		
• Ammonia solution	Ammonium hydroxide	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• Lithium carbonate solution	Lithium carbonate	Toxic HW
• Celloidin	Ethanol, ethyl ether, celloidin (nitrocellulose, parlodion)	Ignitable HW as a liquid, Flammable Solid HW or Explosive IF DRY
• Glycerin water mounting medium	Glycerin, phosphate buffered solute	Not regulated as HW

Stain Solutions	Constituents	Disposal Option
Congo Red Stain (Amyloid)		
• 80% Alcohol & sodium chloride (saturated)	Sodium chloride, ethanol	Ignitable HW
• Alkaline salt solution	80% alcohol, sodium hydroxide	Ignitable HW, check pH for corrosivity
• Stock Congo red staining solution	Congo red, 80% alcohol	Ignitable HW
Elastic Van Gieson Stain		
• Acid fuchsin - 1%	Acid fuchsin	Not regulated as HW
• Picric acid, saturated solution	Picric acid	Corrosive, Flammable Solid HW
• Van Gieson's solution	Acid fuchsin, picric acid	Corrosive, Flammable Solid HW
Fite's Acid Fast Stain		
• Ziehl-Neelsen carbol-fuchsin solution	Phenol, absolute alcohol, basic fuchsin	Toxic HW
• Decolorizing solution	70% Ethanol, hydrochloric acid	Ignitable HW
• Methylene blue counterstain	Methylene blue, acetic acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
Fontana-Masson Stain		
• 10% Silver nitrate	Silver nitrate	Oxidizer HW
• Fontana's silver solution	Silver nitrate, ammonium hydroxide	Corrosive, Oxidizer HW
• 0.2% Gold chloride solution	Gold chloride	Not regulated as HW (but reclaim the gold if possible)
• 5% Sodium thiosulfate solution	Sodium thiosulfate	Not regulated as HW
• Nuclear fast red counterstain solution	Nuclear fast red, aluminum sulfate	Not regulated as HW
Giemsa (Modified Max-Gruenwald) Stain		
• Stock Jenner solution	Jenner dye, methanol	Ignitable and Toxic HW
• Working Jenner Solution	Stock Jenner solution	Ignitable and Toxic HW
• Stock giemsa solution	Giemsa powder, glycerin, methanol	Ignitable, Toxic and Persistent HW
• Working giemsa solution	Stock giemsa solution	Not regulated as HW
• 1% Acetic water solution	Glacial acetic acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit

Stain Solutions	Constituents	Disposal Option
Gram (Modified Brown-Brenn) Stain		
• 1% Crystal violet solution	Crystal violet	Toxic HW
• Grams iodine solution	Iodine, potassium iodide	May be regulated as tissue corrosive
• Stock basic fuchsin solution	Basic fuchsin	Persistent HW
• Working basic fuchsin solution	Stock basic fuchsin solution	Not regulated as HW
Gridley's Ammoniacal Silver Nitrate Solution[1]		
• Ammoniacal silver nitrate solution	Sodium hydroxide, silver nitrate, ammonium hydroxide,	Corrosive, Oxidizer HW. Potentially Explosive HW, can deactivate prior to disposal
• 1% Periodic Acid	Periodic acid	Test for oxidizer, otherwise not regulated as HW
• 2% Silver Nitrate	Silver nitrate	Toxic, Oxidizer HW
• Formalin Solution	Formaldehyde	Toxic HW
• 0.2% Gold Chloride	Gold chloride	Not regulated but reclaim gold if possible
• 5% Sodium Thiosulfate	Sodium thiosulfate	Not regulated as HW
Grocall's Methenamine Silver (GMS) Stain		
• 5% Chemical acid solution	Chromium trioxide	Toxic HW, test for oxidizer, check pH for corrosivity
• Silver nitrate solution	Silver nitrate	Toxic Oxidizer HW
• 3% Methenamine solution	Hexamethylenetetramine	Flammable Solid HW
• 5% Borax solution	Sodium borate	Not regulated as HW
• Stock Methenamine-silver nitrate solution	3% Methenamine, 5% silver nitrate solutions	Toxic Flammable Solid HW
• Working methenamine-silver nitrate solution	5% Borax solution, methenamine-silver nitrate stock	Toxic Flammable Solid HW
• 1% Sodium bisulfite solution	Sodium bisulfite	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• 0.1% Gold chloride solution	Gold chloride	Not regulated but reclaim gold if possible
• 2% Sodium thiosulfate solution	Sodium thiosulfate	Not regulated as HW
• Stock light green solution	Light green SF (yellowish), glacial acetic acid	Not regulated as HW
• Working light green solution	Stock light green solution	Not regulated as HW

Stain Solutions	Constituents	Disposal Option
Hypo (Sodium Thiosulfate)		
• 3% Sodium thiosulfate solution	Sodium thiosulfate	Not regulated as HW
• Lugol's iodine for mercury removal	Iodine, potassium iodide	Corrosive HW
• 2% Hydrochloric acid	Hydrochloric acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• Nuclear-fast red solution	Nuclear-fast red, aluminum phosphate, thymol	Not regulated as HW
Iron Stain (Prussian Blue)		
• 2% Potassium ferricyanide solution	Potassium ferricyanide	Not regulated as HW but not allowed to sewer
Jones Silver Stain		
• 0.5% Periodic acid solution	Periodic acid	Test for oxidizer, otherwise not regulated as HW
• 3% Methenamine solution	Hexamethylenetetramine	Flammable Solid HW
• Borate buffer solution	Boric acid, sodium borate	Check pH for corrosivity
• 5% Silver nitrate solution	Silver nitrate	Toxic, Oxidizer HW
• Working methenamine silver solution	3% Methenamine solution, 5% silver nitrate solution, borate buffer solution	Test for oxidizer, then test for toxicity
• 0.2% Gold chloride solution	Gold chloride	Not regulated but reclaim gold if possible
• 3% Sodium thiosulfate	Sodium thiosulfate	Not regulated as HW
Mucicarmine Stain		
• Mucicarmine stock solution	Carmine alum lake, aluminum hydroxide, ethanol, aluminum chloride	Ignitable HW, check pH for corrosivity
• Mucicarmine working solution	Mucicarmine stock solution	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• Weigert's iron hematoxylin, solution A	Hematoxylin, ethanol	Ignitable HW
• Weigert's iron hematoxylin, solution B	Hydrochloric acid, ferric chloride	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• Weigert's iron hematoxylin solution	Hematoxylin solution A and solution B	Ignitable HW, check pH for corrosivity
• 0.25% Metanil yellow solution	Metanil yellow, acetic acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit

Stain Solutions	Constituents	Disposal Option
Oil Red O Stain		
• Oil red O stock solution	Oil red O, 98% isopropanol	Toxic, Ignitable HW
• Oil red O working solution	Oil red O stock solution	Toxic, Ignitable HW
Periodic Acid Schiff Stain (PAS)		
• 0.5% Periodic acid solution	Periodic acid	Test for oxidizer, otherwise not regulated as HW
• IN hydrochloric acid	Hydrochloric acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• Schiff reagent	Basic fuchsin, sodium metabisulfite, IN hydrochloric acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• 0.55% Potassium metabisulfite solution	Potassium metabisulfite	Not regulated as HW
Periodic Acid Shiff Digested Stain (PAS-D)		
• 0.55% Potassium metabisulfite solution	Potassium metabisulfite	Not regulated as HW
• Malt diastase solution	Diastase of malt, pH 6.0 phosphate buffer	Not regulated as HW
• Phosphate buffer	Sodium chloride, sodium phosphate monobasic	Not regulated as HW
Phosphotungstic Acid Hematoxylin (PTAH)		
• PTAH working solution	Hematoxylin, phosphotungstic acid, potassium permanganate	Test for corrosivity & oxidizer, otherwise not regulated as HW. Must meet sewer limits
• Eosin Y working solution	Eosin Y, 95% ethanol , glacial acetic acid	Ignitable HW
Reticulin Stain (Gomori's Method) [1]		
• 10% Silver nitrate solution	Silver nitrate	Oxidizer HW
• 10% Potassium hydroxide solution	Potassium hydroxide	Corrosive HW
• Ammoniacal silver solution	Sodium hydroxide, silver nitrate, ammonium hydroxide,	Corrosive, Oxidizer HW. Potentially Explosive HW, can deactivate prior to disposal
• 0.5% Potassium permanganate solution	Potassium permanganate	Test for oxidizer, otherwise not regulated as HW
• 2% Potassium metabisulfite solution	Potassium metabisulfite	Not regulated as HW
• 2% Ferric ammonium sulfate solution	Ferric ammonium sulfate	Not regulated as HW
• Formalin solution	Formaldehyde	Toxic HW
• 0.2% Gold chloride solution	Gold chloride	Not regulated but reclaim gold if possible

Stain Solutions	Constituents	Disposal Option
Reticulin Stain (Gomori's Method) - continued		
• 2% Sodium thiosulfate solution	Sodium thiosulfate	Not regulated as HW
• Nuclear-fast red (Kernechtrot) solution	Nuclear-fast red, aluminum sulfate	Not regulated as HW
Spirochete Stain (Steiner & Steiner Method)		
• 1% Uranyl nitrate solution	Uranyl nitrate	Not regulated as HW or radioactive waste. Meets DOH guidelines for sewer discharge.
• 1% Silver nitrate solution	Silver nitrate	Oxidizer HW
• 0.04% Silver nitrate solution	Silver nitrate	Toxic HW. Test for oxidizer.
• 2.5% Gum mastic solution	Gum mastic, absolute alcohol	Ignitable HW
• 2% Hydroquinone solution	Hydroquinone	Toxic HW
• Reducing solution	Gum mastic solution, hydroquinone solution, absolute alcohol	Ignitable HW
Trichrome Stain – Masson's Method		
• Bain's solution	Picric acid, glacial acetic acid, formaldehyde	Toxic HW, test pH for corrosivity
• Weigert's iron hematoxylin, solution A	Hematoxylin, 95% alcohol	Ignitable HW
• Weigert's iron hematoxylin, solution B	Ferric chloride, glacial acetic acid	Corrosive HW
• Weigert's iron hematoxylin, working solution	Solution A, solution B	Ignitable HW, test pH for corrosivity
• Biebrich scarlet – acid fuchsin solution	1% Biebrich scarlet solution, 1% acid fuchsin, acetic acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• Phosphomolybdic – phosphotungstic acid solution	Phosphomolybdic acid, phosphotungstic acid	Test for oxidizer, test pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• Aniline blue solution	Aniline blue, acetic acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• 1% Acetic acid solution	Glacial acetic acid	Check pH for corrosivity, otherwise not regulated as HW, must meet sewer limit
• Toluidine blue stain solution (for mast cells)	Toluidine blue	Not regulated as HW

Stain Solutions	Constituents	Disposal Option
Vonkossa Stain for Calcium		
• 5% Silver nitrate solution	Silver nitrate	Oxidizer HW
• 5% Sodium thiosulfate	Sodium thiosulfate	Not regulated as HW
• Nuclear-fast red solution	Nuclear-fast red, aluminum sulfate	Not regulated as HW
Fixative	**Constituents**	**Disposal Option**
Miscellaneous Fixatives		
• Alcohol fixatives	Methanol, ethanol	Methanol is Toxic Ignitable HW, Ethanol is Ignitable HW
B-5 Fixative		
• Stock solution	Mercuric chloride, sodium acetate (anhydrous)	Toxic HW
• Working solution	B-5 stock solution, formaldehyde solution	Toxic HW
• Bouin's fixative solution	Picric acid (saturated), 37% formaldehyde solution, acetic acid	Toxic HW, check for corrosivity
Carnoy's Fixatives		
• Carnoy's fixative I	Acetic acid, ethanol	Corrosive, Ignitable HW
• Carnoy's fixative II[2]	Chloroform, acetic acid, ethanol	Corrosive, Ignitable, Toxic HW
• Propionic acid – ethanol solution	Propionic acid, ethanol	Ignitable HW
Formalin Fixatives		
• 10% Aqueous formalin solution	Formaldehyde	Toxic HW
• 10% Aqueous saline formalin solution	Formaldehyde, sodium chloride	Toxic HW
• 10% Neutral buffered formalin	Formaldehyde, sodium phosphate monobasic, sodium phosphate dibasic	Toxic HW
• Formalin alcohol solution	Formaldehyde, ethanol	Ignitable Toxic HW
• Hollande's fixative solution	Copper acetate, picric acid, formaldehyde, acetic acid	Toxic HW
Zenker's Fixative Solutions		
• Stock solution	Mercuric chloride, potassium dichromate, sodium sulfate	Toxic HW, test to see if oxidizer or corrosive
• Working solution	Zenker's stock solution, acetic acid	Toxic HW, test to see if oxidizer or corrosive

[1] Ammoniacal silver staining solutions are hazardous due to their potential to form explosive silver salts. Whether disposed or deactivated, these wastes are counted against your generator status.

- Don't allow silver nitrate to remain in ammonium solutions for more than two hours.

- Keep silver nitrate solutions separate from ammonium hydroxide solutions.
- Deactivate these waste solutions by diluting 15:1 with water. Then, while stirring frequently, slowly adding 5% hydrochloric acid to the solution till the pH reaches 2.
- Add ice if the solution heats up. Silver chloride will precipitate out when the pH reaches 2.
- Filter out the precipitate and dispose as hazardous waste, adjust the pH of the solution to 6 to 7 with sodium bicarbonate, then discharge to the sewer.

[2] A chloroform-free alternative, Carnoy's 2000™, is available from American Master*Tech Scientific, Inc.

APPENDIX D

SOLID WASTE DISPOSAL - COMMON QUESTIONS

What is "Solid Waste?"

- "Solid Waste" refers to materials allowed in local municipal collection systems for garbage and recycling.

Who do I call to find out if my waste is acceptable for disposal as solid waste?

- Contact the Public Health – Seattle & King County Waste Characterization Program at 206-296-4633 or e-mail wc@metrokc.gov.

Who do I call to get my waste cleared for disposal as solid waste?

- Contact the Waste Characterization Program at 206-296-4633 or e-mail wc@metrokc.gov.

What are the guidelines for disposal of biomedical wastes? Who do I call for info?

- Untreated medical wastes are NOT allowed in the landfill. For more information on biomedical waste disposal, contact the medical waste coordinator for Public Health – Seattle & King County at 206-296-4831. See http://www.metrokc.gov/health/hazard/solidwaste.htm#biomedical

Where does my solid waste go for disposal?

- Wastes generated within the Seattle city limits are disposed at Columbia Ridge Landfill, Oregon.
- Wastes generated in King County, outside the Seattle city limits, go to Cedar Hills Landfill near Issaquah

What process must I go through to get a clearance for questionable solid waste?

- Contact the Waste Characterization program at 206-296-4633 or e-mail wc@metrokc.gov, describe your waste and ask for instructions about the information needed to determine its acceptability.
- They will answer your questions and send you a two-page Waste Characterization Form. Download the form on-line at http://www.metrokc.gov/health/hazard/wcform.doc
- Complete the form and submit it with the appropriate data (typically material safety data sheets and/or results of laboratory analyses).
- If the waste is from Seattle, they'll review the information and, if it is acceptable, issue a permit.
- If the waste is from King County, outside Seattle, they'll review the information and issue a technical report. If the waste is acceptable, King County Solid Waste will issue a permit.

Can I dispose of "Special Wastes" at King County or Seattle solid waste facilities?

- Not at this time. Special Wastes are defined in WAC 173-303-040 as state-only dangerous waste that is solid only and is either:
  A. Corrosive;
  B. Category D toxic;
  C. PCB Waste; or
  D. Persistent waste that is not extremely hazardous.

Note: Some "special dangerous wastes" are allowed for local landfill disposal, generally only if they are toxic category D and a solid. Contact the Waste Characterization program at 206-296-4633 or e-mail wc@metrokc.gov for potential approval.

There are now some firms offering direct haul service for "special wastes." Call the Waste Characterization Program at 206-296-4633 or e-mail wc@metrokc.gov for more information.

What common solid wastes from labs may not be acceptable?

- Buffers consisting of more than 10% toxic category D substances (e.g., potassium hydroxide)
- Drier packages with over 10% potassium chloride, sodium chloride or copper chloride
- Soil samples with these characteristics:
  A. Contains three percent (3%) or more total petroleum hydrocarbons;
  B. Contains contaminants which occur at concentrations at or above a dangerous waste threshold in the toxicity characteristics list (see WAC 173-303-090 [8] [c])
- Many lab stains and dyes can designate because they are halogenated organic compounds (e.g., bromophenol blue).

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RCRA Training Module

Solid Waste and Emergency Response
(5305W)
EPA530-K-05-013

Introduction to

Land Disposal Restrictions

(40 CFR Part 268)

United States
Environmental Protection
Agency

September 2005

LAND DISPOSAL RESTRICTIONS

CONTENTS

1. INTRODUCTION

The primary goal of the Resource Conservation and Recovery Act (RCRA) Subtitle C program is to protect human health and the environment from the dangers associated with generation, transportation, treatment, storage, and disposal of hazardous waste. Disposal of hazardous waste on the land is a practice of particular concern to the RCRA program. Land disposal units, such as landfills and surface impoundments, must comply with stringent requirements for liners, leak detection systems, and groundwater monitoring. The land disposal restrictions (LDR) provide a second measure of protection from threats posed by hazardous waste disposal. The LDR program ensures that hazardous waste cannot be placed on the land until the waste meets specific treatment standards to reduce the mobility or toxicity of the hazardous constituents in the waste. This training module presents an overview of the land disposal restrictions program.

When you have completed this module, you will be able to describe the LDR requirements. Specifically, you will be able to:

- define the basic terms and describe the structure of the LDR regulations
- identify the statutory basis for LDR
- describe the applicability of LDR
- explain how EPA sets treatment standards
- identify treatment standards for wastes subject to land disposal restrictions and cite the CFR section
- describe and identify how extensions and variances from treatment requirements are obtained
- define generator and treatment, storage, and disposal facility (TSDF) requirements under the LDR program
- summarize the schedule of existing restrictions and the plan for restricting newly identified wastes.

Use this list of objectives to check your knowledge of this topic after you complete the training session.

2. REGULATORY SUMMARY

The LDR program found in 40 CFR Part 268 requires waste handlers to treat hazardous waste or meet specified levels for hazardous constituents before disposing of the waste on the land. This is called the disposal prohibition. To ensure proper treatment, EPA establishes a treatment standard for each type of hazardous waste. The Agency lists these treatment standards in Part 268, Subpart D. The Agency expresses treatment standards either as required treatment technologies that must be applied to the waste or contaminant concentration levels that must be met. EPA bases treatment standards on the performance of the best demonstrated available technology (BDAT) that is able to substantially diminish the toxicity of a waste or to reduce the mobility of the hazardous constituents in a hazardous waste. Wastes that do not meet treatment standards cannot be land disposed unless EPA has granted a variance, extension, exclusion, or the waste is managed pursuant to an approved "no migration" petition. In addition to the disposal prohibition, there are prohibitions and limits in the LDR program regarding the dilution and storage of wastes. The program also requires tracking and recordkeeping to ensure proper management and safe land disposal of hazardous wastes.

2.1 HISTORY OF THE LDR PROGRAM

The Hazardous and Solid Waste Amendments of 1984 (HSWA) established EPA's authority for the LDR program. Due to the large number of hazardous waste codes that existed prior to HSWA, EPA developed LDR treatment standards in stages. In HSWA, Congress set a time frame for the implementation of treatment standards for all wastes listed or identified as hazardous on or before November 8, 1984. Congress set specific prohibition dates for certain high-risk and high-volume wastes and established a three-part schedule with specific deadlines for EPA to develop treatment standards for the remaining listed and characteristic wastes. Wastes identified subsequent to HSWA are considered newly identified or listed. Additional rulemakings, promulgated in “phases,” addressed these new wastes. This section highlights some especially pertinent parts of those rulemakings and identifies and explains certain complex areas.

SOLVENT AND DIOXIN-CONTAINING WASTE

Solvent and dioxin-containing wastes were the first group of wastes for which EPA established treatment standards. Congress set a statutory deadline for EPA to establish treatment standards for these wastes because they are generated either in high volumes (solvent wastes) or are considered highly toxic (dioxin-containing wastes). EPA published a final rule on November 7, 1986 (51 FR 40572), establishing effective dates and treatment standards for F001-F005 solvent wastes (§268.30) and F020-F023 and F026-F028 dioxin-containing wastes (§268.31). The November 7, 1986, final rule also established the basic framework for the land disposal restrictions program.

CALIFORNIA LIST WASTE

A second group of hazardous wastes for which Congress set a specific LDR deadline is known as the California list. This list was compiled from a program established by California's

Department of Health Services. The California list, which became effective July 8, 1987, prohibited the land disposal of liquid hazardous wastes containing certain toxic constituents or exhibiting certain properties unless subjected to prior treatment (52 FR 25760; July 8, 1987). The targets of the list included cyanides, polychlorinated biphenyls (PCBs), halogenated organic compounds (HOCs), and metals. Certain HOC-containing wastes were also prohibited even when in solid form.

Waste code-specific treatment standards addressing the constituent (or property) of concern have superseded the California list prohibitions. For example, the treatment standard for D008 (i.e., the toxicity characteristic for lead) supersedes the California list prohibition on liquid hazardous wastes containing lead. On May 12, 1997, EPA removed all references to the California list wastes because the treatment standards for these wastes had been superseded by more specific treatment standards (62 FR 25998).

THIRDS

HSWA §3004(g)(4) required EPA to prepare a plan by November 8, 1986, to meet the Congressionally mandated schedule for establishing treatment standards for all hazardous wastes identified or listed on or before November 8, 1984. When developing the plan, EPA was required to rank the listed wastes from high to low priority, based on the wastes' intrinsic hazard and volume generated. The Agency scheduled high-volume, high-intrinsic hazard wastes first, while low-volume, lower-hazard wastes (including characteristic wastes) were to have treatment standards established last. Wastes with treatment standards promulgated in the first portion of the three-part schedule are known as First Third wastes (53 FR 31138; August 17, 1988), wastes addressed in the second portion of the schedule are known as Second Third wastes (54 FR 26594; June 23, 1989), and wastes in the third category are known as Third Third wastes (55 FR 22520; June 1, 1990).

TREATMENT STANDARDS FOR NEWLY IDENTIFIED OR LISTED WASTES

HSWA also requires EPA to establish treatment standards for all hazardous wastes listed or identified after November 8, 1984. EPA developed treatment standards for these wastes in phases. EPA published the first of these rulemakings, termed Phase I,on August 18, 1992 (57 FR 37194). In addition to promulgating restrictions for certain new wastes, Phase I finalized the alternative treatment standards for hazardous debris.

EPA finalized the Phase II Rule on September 19, 1994 (59 FR 47982). This final rule consolidated the existing treatment standards into §268.40, created the Universal Treatment Standards (UTS), and promulgated treatment standards for toxicity characteristic organic wastes, coke by-products, and chlorotoluenes.

EPA finalized the Phase III Rule and subsequent partial rescission on April 8, 1996 (61 FR 15566 and 15660). These final rules modified treatment standards for reactive wastes and decharacterized wastewaters (see Section 2.8 for a complete discussion on the status of wastewaters), and promulgated new treatment standards for carbamate wastes and spent aluminum potliners. Even though Phase III promulgated treatment standards for these newly-identified carbamate wastes, in the case, *Dithiocarmbamate Task Force v. EPA*, the DC Circuit

Court of Appeals vacated several carbamate hazardous waste listings, thus nullifying their corresponding LDR treatment standards (62 FR 32974; June 17, 1997).

EPA finalized the first half of the Phase IV Rule on May 12, 1997 (62 FR 25998). This final rule promulgated treatment standards for the wood preserving wastes and streamlined the LDR notification requirements. EPA promulgated part two of the Phase IV Rule on May 26, 1998 (63 FR 28556). This rule finalized treatment standards for several metal wastes and certain newly-identified mineral processing wastes, and revised the universal treatment standards for twelve metal constituents. The rule also created a new treatability group, soil, and established soil-specific alternative treatment standards.

2.2 LDR AND EPA'S GROUNDWATER PROTECTION STRATEGY

A large part of the hazardous waste management regulatory program, including the LDR program, is designed to protect groundwater. Hazardous waste can pollute groundwater through a process known as leaching, in which precipitation percolating through the ground draws contaminants out of buried waste and carries them into groundwater. Congress understood that hazardous waste could be made less dangerous to groundwater in two main ways: by reducing a waste's toxicity through destruction or removal of harmful contaminants, or by reducing a waste's leachability by immobilizing hazardous contaminants. As a result, EPA created a tiered approach to the protection of groundwater by attempting to prevent leachability of harmful constituents at three levels: LDR, LDUs, and groundwater monitoring. The first tier of the approach, LDR, regulates what kind of waste can be placed on the land or in land disposal units. This training module focuses on the LDR provisions, but more information on the other two tiers of the groundwater protection strategy can be found in the modules entitled Land Disposal Units and Groundwater Monitoring.

LDR requires that hazardous wastes undergo fundamental physical or chemical changes so that they pose less of a threat to groundwater. When directing EPA to establish the LDR program in RCRA §3004(m), Congress specified that EPA should "promulgate regulations specifying those levels or methods of treatment, if any, which substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste." To implement that goal, Congress gave EPA very specific directions for establishing the LDR program. In particular, Congress required EPA to specify how hazardous wastes should be treated to satisfy LDR's goal of groundwater protection. The rules EPA promulgated governing how different hazardous wastes must be treated are known as treatment standards. Treatment standards are simply instructions on how a hazardous waste should be treated.

For example, many of the chemicals capable of contaminating groundwater are organic compounds. Incineration or burning can destroy these organic compounds, usually breaking them down into less dangerous by-products like carbon dioxide and water. Thus, incineration of organic-bearing hazardous wastes can protect groundwater by destroying organic contaminants before they have a chance to enter underground water supplies. The obvious advantage of such hazardous waste treatment is that it provides a more permanent and lasting form of groundwater protection than hazardous waste containment. Structural barriers separating hazardous contaminants from groundwater may eventually break down or leak. In contrast, treatment that

destroys harmful contaminants or reduces a waste's toxicity before it enters the environment is a permanent groundwater protection solution.

Treatment, however, cannot destroy all types of contaminants found in hazardous waste. In particular, metal elements, which are common toxic contaminants, cannot be broken down through combustion. Treatment techniques other than incineration, however, can be used for such wastes. For example, through a process called stabilization or immobilization, metal contaminants can be chemically and physically bound into the wastes that contain them. Although this treatment method does not reduce the overall concentration of toxic metals in a hazardous waste, it does immobilize these constituents, making them less likely to leach from the waste. Reducing the mobility or leachability of hazardous constituents in a waste is another means of achieving LDR's groundwater protection goal.

2.3 APPLICABILITY

To be subject to the land disposal restrictions, a waste must first be a RCRA hazardous waste. Unless a waste meets the definition of a solid and hazardous waste, its disposal will not be subject to the LDR program.

RCRA §3004(g) requires that EPA restrict hazardous wastes from land disposal within six months of promulgating a new listing or characteristic. Until the Agency establishes a treatment level, newly listed or identified wastes are not subject to LDR and they may continue to be land disposed. Generally, EPA now promulgates new listings and their treatment standards at the same time. Once EPA promulgates final treatment requirements waste handlers must manage it in accordance with all the requirements of Part 268 and cannot land dispose the waste until it meets the treatment level.

EXCLUSIONS

While the LDR program generally applies to all persons who generate, transport, treat, store, or dispose of a restricted hazardous waste, EPA excludes certain wastes from the applicability of Part 268. The following hazardous wastes are not subject to the requirements of LDR (§268.1(e)):

- waste generated by conditionally exempt small quantity generators as defined in §261.5
- waste pesticide and container residues disposed of by farmers on their own land pursuant to §262.70
- newly identified or listed hazardous wastes for which EPA has yet to promulgate land disposal restriction treatment standards
- certain low volume releases, known as de minimis losses, and laboratory wastes that are mixed with a facility’s wastewater and are discharged to the facility's wastewater treatment or pretreatment facility.

Waste handlers may continue to land dispose wastes meeting any of these descriptions without being subject to the LDR program. They must manage other restricted hazardous wastes in compliance with the requirements in Part 268 unless explicitly exempted by another part of the RCRA program.

2.4 TREATMENT STANDARDS

LDR requires waste handlers to fundamentally change the threat posed by hazardous waste before it is land disposed. Waste-specific restrictions are manifested as thresholds for adequate treatment, known as treatment standards. Once EPA restricts a waste and issues a treatment standard, the waste may be land disposed only after it meets the appropriate treatment standard.

ESTABLISHMENT OF TREATMENT STANDARDS

Section 3004(m) of the Hazardous and Solid Waste Amendments (HSWA) requires EPA to promulgate treatment standards that reduce the toxicity or mobility of hazardous constituents to minimize the short and long-term threats to human health and the environment. To implement this mandate, EPA chose to base treatment standards on technical practicability instead of risk assessment. To this end, EPA conducts research into available treatment technologies. Of all the proven, available technologies, EPA designates the ones that best minimize the mobility and/or toxicity of hazardous constituents as the Best Demonstrated Available Technology (BDAT) for that waste. The Agency then establishes a waste code-specific treatment standard based on the performance of BDAT, incorporating any existing constituent treatment levels specified as universal treatment standards (UTS), which are discussed later in this section. EPA expresses these treatment standards as either concentration levels or required technologies.

When EPA sets treatment standards as concentration levels, they do not limit the allowable method of treatment to the BDAT used to establish the treatment standard; instead, the Agency uses BDAT to determine the appropriate level of treatment for each hazardous constituent commonly found in the waste. The regulated community may then use any method or technology to meet the treatment standard, except for instances where application of a method or technology would be impermissible dilution. A generator fully treating the waste before sending it off site or a TSDF treating the waste must analyze the waste pursuant to a waste analysis plan to determine that it meets the applicable concentration-based standards in §268.40.

When a treatment standard is a required technology, the generator or facility treating the waste must use that technology, unless it can demonstrate that an alternative method can achieve a level of performance equivalent to the required technology (discussed in Section 2.4). Whenever possible, EPA prefers to use numeric treatment standards in order to stimulate innovation and development of alternative treatment technologies.

Since the physical and chemical composition of a waste significantly impacts the effectiveness of a given treatment technology, EPA divides the treatment standard for each waste code into two categories: wastewaters and nonwastewaters. The Agency defines these two categories based on the percentages of total organic carbon (TOC) and total suspended solids (TSS) present in a waste, since these factors commonly impact the effectiveness of treatment methods.

Wastewaters contain less than one percent TOC by weight and less than one percent TSS by weight. Nonwastewaters include wastes that do not meet the definition of wastewater (§268.2).

EPA also developed alternative treatment standards for soil, debris, and lab pack wastes. The alternative treatment standards will be discussed in the "Alternative Treatment Standards" section of this module.

CONSOLIDATED TABLE OF TREATMENT STANDARDS

EPA originally presented the treatment standards for hazardous wastes in multiple tables, but replaced these with a single consolidated table for wastewaters and nonwastewaters. If EPA restricts a hazardous waste from land disposal, the treatment standard for both wastewaters and nonwastewaters appears in §268.40. Section 268.40 expresses treatment standards in three ways:

- constituent concentrations in mg/kg of the waste
- constituent concentrations in an extract of the waste expressed in mg/l
- treatment standards expressed as specified technologies and represented by a five-letter code (described in §268.42).

EPA commonly expresses numeric standards in mg/kg when BDAT is a destruction or extraction technology such as incineration. Waste handlers measure compliance with these treatment standards by analyzing a representative sample of the waste for the total concentration of each hazardous constituent identified in the treatment standard and comparing it to the level given for the waste code.

EPA also expresses concentration-based treatment standards in mg/l. For wastewaters, waste handlers demonstrate compliance by comparing the concentration of hazardous constituents found in a composite sample of the waste with the regulatory level. For nonwastewaters, the waste handler prepares an extract that reflects the leaching potential of hazardous constituents in the waste. The waste meets the treatment standard if the concentration of regulated constituents in the liquid extract falls below the regulatory levels given for the waste code. EPA requires the use of the Toxicity Characteristic Leaching Procedure (TCLP) to obtain the waste extract. The older and less sensitive Extraction Procedure (EP) was available for use until August 24, 1998.

EPA also expresses treatment standards in §268.40 as specified technologies for certain wastes. Waste handlers must treat these wastes using the specified technology. Table 1 in §268.42 provides full descriptions of the technologies represented by the five-letter codes used in §268.40. Examples include incineration (INCIN), fuel substitution (FSUBS), and mercury retorting (RMERC). In most cases, once treated by the required technology, wastes can be land disposed without being tested. There are, however, some exceptions. For example, all F024 wastes must be incinerated. Following incineration, the remaining residues must then also meet the concentration levels specified in §268.40.

UNIVERSAL TREATMENT STANDARDS

Use of BDAT to set treatment standards for hazardous wastes gave rise to an unintended consequence: the numeric treatment standard applied to an individual hazardous constituent, like benzene, could vary depending on the performance of BDAT on each listed or characteristic wastestream that EPA evaluated. For example, nonwastewater forms of the listed wastes F005 and U019 both require treatment for benzene; however, the treatment standard originally set for benzene in the spent solvent was 3.7 mg/kg, while the standard originally set for unused, discarded benzene was 36 mg/kg.

To simplify the LDR program and eliminate this inconsistency between standards, the Agency examined the range of numeric standards applied to each hazardous constituent found in restricted hazardous wastes. Based on the range, EPA assigned a single numeric value to each constituent for its respective wastewater and nonwastewater forms. A consolidated list of each constituent and its treatment standards (wastewater and nonwastewater) appears in §268.48 and is known as the UTS table. EPA used the values assigned to hazardous constituents in UTS to adjust numeric levels found in the treatment standards table in §268.40. Applying these universal treatment standards has not changed the hazardous constituents that waste handlers must treat in a particular waste, as EPA only amended the numeric standards. As a result, a common constituent found in multiple, different wastes will nonetheless carry the same numeric treatment level. The treatment standards found in §268.40 for F005 and U019 nonwastewaters, therefore, continue to address benzene, but EPA has adjusted the level for each to 10 mg/kg.

The creation of UTS simplifies the process of assigning treatment standards to wastes that are newly identified or listed in the future. When a new waste contains hazardous constituents that EPA has already addressed in UTS, the Agency will apply the existing BDAT-based numeric standards for those particular constituents. EPA can individually evaluate constituents not already included in UTS and add them to §268.48.

2.5 ALTERNATIVE TREATMENT STANDARDS

In addition to these waste code or site-specific exception procedures, the Agency also created a number of broad alternative treatment standards that facilities may choose to use in lieu of meeting the waste code-specific treatment standards. These alternative treatment standards are only available for certain forms of restricted wastes.

TREATMENT STANDARDS FOR CONTAMINATED SOIL

Remediation of hazardous waste sites will often produce contaminated soil that the generator must handle as hazardous waste if it contains a listed hazardous waste or if it exhibits a characteristic of hazardous waste. These remediation wastes, due to either their large volume or unique properties, are not always amenable to the treatment standards for hazardous wastewater and nonwastewater. Because of this, EPA designated soil as a unique treatability group and promulgated alternative soil-specific treatment standards in the Phase IV Final Rule (63 FR 28556; May 26, 1998). As with hazardous waste, RCRA prohibits the land disposal of hazardous soil until the soil has been treated to meet LDR standards.

A facility may treat contaminated soil to meet the waste-specific treatment standard in §268.40, (i.e., the same standard the waste would have to meet if it was newly generated rather than found in soil) or to meet the soil-specific standards in §268.49. The soil standards mandate reduction of hazardous constituents by 90 percent, capped at 10 times the UTS. This means that if a 90 percent reduction of a particular constituent would bring the constituent concentration to below 10 times the UTS level, treatment need only achieve the 10 times UTS level. If the 90 percent reduction is higher than 10 times UTS, treatment need only achieve the 90 percent reduction. For example, a contaminated soil contains 400 mg/l nickel. Reducing this by 90 percent would mean treating the waste to 40 mg/l. However, the UTS for nickel is 11 mg/l, so 10 times the UTS would be 110 mg/l. Therefore, this soil would only require treatment to 110 mg/l to meet the LDR soil treatment standards.

Waste handlers may also treat soils that exhibit a characteristic of hazardous waste using these soil standards. Following treatment, however, the soil may still exhibit a characteristic of hazardous waste, since the 10 times UTS level is sometimes above the hazardous waste characteristic level (e.g., 10 times UTS for lead is 7.5 mg/l, while the toxicity characteristic level is 5 mg/l). Because these soils would still be hazardous wastes, they would require disposal in a Subtitle C facility. Soils that are no longer characteristic may be sent to a Subtitle D facility or placed back on the land. Soils contaminated with listed wastes continue to carry the listed code and must be managed in Subtitle C facilities even after meeting the LDR treatment standards, unless the facility gets a site-specific ruling from their implementing agency.

Like all LDR treatment standards, the soil treatment standards are promulgated pursuant to HSWA. Because the soil treatment standards are generally less stringent than current federal requirements, they will not go into effect in authorized states until the states adopt and become authorized for them, even though the soil treatment standards are promulgated pursuant to HSWA.

If a state is authorized to implement the LDR treatment standards for any given waste or constituent, and that waste or constituent is contained in contaminated soil that is subject to LDR, then, generally, the more stringent treatment standard for the as-generated industrial waste or constituent applies to contaminated soil until the state adopts and becomes authorized for the soil treatment standards. This would not be the case if the state implements state waiver authorities or other state laws to allow compliance with the soil treatment standards in advance of adoption or authorization. (See EPA guidance memorandum from J. Winston Porter to EPA Regional Administrators, "RCRA Permit Requirements for State Superfund Actions," November 16, 1987, OSWER Directive 9522.00-2.) Similarly, if a state has adopted, under state law, an authorization for the requirement, and that waste or constituent is contained in contaminated soil that is subject to LDR, the more stringent state requirement continues to apply until the state adopts, under state law, the soil treatment standards. Once again, the state may implement state waiver authorities or other state laws to allow compliance with the soil treatment standards in advance of adoption or authorization. Therefore, facility representatives should contact their state regulatory agency before undertaking soil remediation to see if the alternative treatment standards are available in their state.

DEBRIS

Section 268.45 contains alternative treatment standards for manufactured items and environmental media of a certain size that are contaminated with hazardous waste. EPA developed these alternative standards because materials such as rocks, bricks, and industrial equipment (known generically as debris) contaminated with hazardous waste may not be amenable to the waste code-specific treatment standards in §268.40.

Section 268.45 allows a waste handler to choose among several types of treatment technologies, based on the type of debris and the waste with which it is contaminated. EPA divided the alternative treatment standards for debris into three technological categories: extraction, destruction, and immobilization. When using an alternate debris treatment standard, waste handlers must ensure that the treatment process meets the design and operating requirements established in §268.45, and that they treat for each contaminant, or hazardous constituent, subject to treatment, as defined in §268.45(b). In order to be eligible for land disposal, the debris must meet the specified performance standards in Table 1 in §268.45. For example, a contaminated boulder that is sandblasted to remove surface contamination must be treated to a "clean debris surface" and at least 0.6 centimeters of the surface layer of the boulder must be removed.

Once the waste handler has treated hazardous debris according to the specification of one of these technologies, it may be land disposed. If treated hazardous debris does not exhibit any characteristic following treatment with an extraction (e.g., sandblasting) or destruction (e.g., incineration) technology, it is eligible for land disposal and can be disposed of as nonhazardous or simply returned to the environment (§261.3(f)). Hazardous debris treated with an immobilization technology (e.g., macroencapsulation) that is no longer characteristic can be disposed of as nonhazardous only after a determination from the implementing agency (§261.3(f)(2)).

LAB PACK WASTES

Laboratories commonly generate small volumes of many different listed and characteristic wastes. Rather than manage all these disparate wastes individually, laboratories commonly take advantage of regulatory provisions that allow them to overpack many small containers of hazardous waste into a larger drum. These containers are known as lab packs. EPA has assigned them an alternative treatment standard, incineration, that allows generators to apply one treatment standard for the entire lab pack rather than applying the treatment standard for each individual waste code contained within the lab pack (§268.42(c)). The primary condition for application of this alternative, however, is that the lab pack may not contain any of the heavy metal-bearing waste codes identified in Part 268, Appendix IV.

2.6 VARIANCES, EXTENSIONS, AND EXEMPTIONS

If a restricted waste does not meet the appropriate treatment standard, it is ineligible for land disposal. Restricted wastes that waste handlers cannot land dispose because they do not yet meet their treatment standards are termed “prohibited” wastes. Although most prohibited wastes

become eligible for land disposal through treatment to the appropriate standards, this may not be possible in all cases. As a result, EPA created procedures that allow waste handlers to land dispose otherwise prohibited wastes under special circumstances. The following exemptions, variances, and extensions established in Part 268 allow wastes for which treatment standards have been promulgated to be land disposed without meeting treatment standards, or to be treated to a less stringent level or by a different technology:

- national capacity variance (§3004(h)(2))
- case-by-case extension to an effective date (§268.5)
- no-migration variance (§268.6)
- variance from a treatment standard (§268.44)
- equivalent treatment method variance (§268.42(b))
- surface impoundment treatment exemption (§268.4).

While wastes subject to any of these provisions continue to be restricted under LDR, they are not prohibited from land disposal under these limited conditions.

NATIONAL CAPACITY VARIANCE

When developing a treatment standard, EPA reviews treatment, recovery, and disposal capacity to see if capacity is adequate for current and future waste management needs. If there is inadequate capacity for certain waste codes, EPA may grant a nationwide extension of the prohibition deadline for up to two years (RCRA §3004(h)(2)). This extension is known as a national capacity variance. To make capacity determinations, EPA compares the quantity of the restricted waste generated with the nationally available treatment, recovery, or protective disposal capacity at permitted and interim status facilities that will be in operation by the effective date. If there is a significant shortage of capacity, EPA will establish an alternative effective date based on the earliest date such capacity will be available. Waste handlers can land dispose waste that benefits from a national capacity variance without meeting the treatment standards. However, if they dispose of the waste in a landfill or surface impoundment, the disposal unit must be in compliance with the minimum technological requirements of RCRA §3004(o).

CASE-BY-CASE EXTENSION

Regional or local conditions may create a lack of adequate treatment capacity in a particular area. In this situation, EPA may extend the effective date of a treatment standard on a case-by-case basis. EPA grants case-by-case extensions for one year, when waste handlers appropriately demonstrate need as enumerated in §268.5, and can renew these extensions for an additional year. Individual extensions cannot exceed a total of 24 months (RCRA §3004(h)(3)).

If waste handlers dispose of hazardous wastes benefiting from a case-by-case extension to an effective date in landfills or surface impoundments, these disposal units must meet the minimum technological requirements for liners and leak-detection and be in compliance with groundwater monitoring requirements (RCRA §3004(o)).

Although case-by-case extensions usually apply only to the waste generated at the individual facility that sought an extension, EPA has, at times, granted "generic" case-by-case extensions with broad applicability. The last of these generic case-by-case extensions to an LDR effective date, a limited extension for the disposal of hazardous debris, expired May 8, 1994.

NO-MIGRATION VARIANCE

Waste handlers can land dispose hazardous wastes subject to LDR in a land-based unit without meeting treatment standards, if a petitioner can demonstrate that there will be no migration of hazardous constituents from the unit for as long as the waste remains hazardous (§268.6). EPA interprets "no migration" to mean that constituents will not leave the unit boundary at concentrations above Agency-approved health-based levels. EPA may grant a no-migration variance for up to 10 years, but may not extend the variance beyond the term of the particular disposal unit's RCRA permit.

No-migration petitions must include a site description, waste characterization, and monitoring plans for evaluation by the Agency. The regulated community must also submit for review long-term modeling estimates of concentrations in the ground's unsaturated zone and the air pathway.

EPA has granted the majority of no-migration petitions to underground wells that inject hazardous waste deep beneath the surface. A notable example is the conditional no-migration variance granted for the U.S. Department of Energy's (DOE's) Waste Isolation Pilot Plant (WIPP) in New Mexico. This variance permits DOE to dispose of untreated mixed radioactive and hazardous wastes in an underground salt dome for the duration of a test period.

VARIANCE FROM A TREATMENT STANDARD

Under certain circumstances, generators or TSDFs may petition the Agency for a variance from using a required technology or from meeting a concentration-based treatment standard. EPA established this variance from a treatment standard to account for those wastes for which applicable treatment standards are unachievable or inappropriate (§268.44). In most cases, petitioners must demonstrate that the waste is significantly different from the wastes evaluated by EPA when developing the codified treatment standard or that such method or standard is unachievable or inappropriate for the waste. A treatability variance may apply generically to all waste meeting a certain description or it may be narrower in scope, applying only to a specific waste generated at a particular site (55 FR 22526; June 1, 1990).

With the establishment of soil-specific standards, EPA promulgated an additional provision in §268.44 for contaminated soil. Pursuant to §268.44(h)(3), variances from otherwise applicable LDR treatment standards may be approved if it is determined that compliance with the treatment standard would result in treatment beyond the point at which short- and long-term threats to human health and the environment are minimized. This allows a site-specific, risk-based determination to supersede the technology-based LDR treatment standards under certain circumstances, allowing regulators to align cleanup levels and treatment levels. Alternative LDR treatment standards established through site-specific risk-based variances should be within the range of values the Agency generally finds acceptable for risk-based cleanup levels. Decisions to grant or deny these variances will be made by EPA Regions or authorized states.

EQUIVALENT TREATMENT METHOD VARIANCE

Generally, waste handlers must treat waste to which EPA has assigned a technology-based treatment standard in §268.40 using that method of treatment prior to disposal. A person may, however, submit an application to the implementing agency demonstrating that an alternative treatment method can achieve a performance equivalent to that of the specified treatment standard and can protect human health and the environment (§268.42(b)). If EPA approves the petition granting an equivalent method variance, the alternative method may be used in lieu of the specified technology.

SURFACE IMPOUNDMENT TREATMENT EXEMPTION

The management of liquid wastes in surface impoundments often serves as a means of treatment. Typically, particulates suspended in liquid wastes settle to the bottom of impoundments, forming sludges in which contaminants concentrate. This precipitation process may result in the generation of sludges that are hazardous wastes. Since management of wastes in surface impoundments is considered land disposal, even though the waste is not permanently disposed in the unit, such generation and placement of hazardous sludges on the land without prior treatment would normally be inconsistent with LDR's disposal prohibition. Section 268.4 allows this practice, however, by providing an exemption for wastes treated in surface impoundments. Waste handlers may treat hazardous waste in surface impoundments without first meeting treatment standards provided that (1) the surface impoundment meets certain technological requirements, (2) the treatment residues that do not meet applicable standards are removed from the impoundment annually, and (3) the removed residues are not managed in another surface impoundment.

2.7 STORAGE AND DILUTION PROHIBITION

In addition to prohibiting the land disposal of wastes that do not meet treatment standards, the LDR program includes two other important prohibitions. One forbids the long-term storage of wastes as a substitute for meeting the required treatment standards. The other prohibits the dilution of wastes as a substitute for legitimate treatment. Like the prohibition on land disposal, these prohibitions no longer apply once a waste meets its waste code-specific treatment standard.

STORAGE PROHIBITION

EPA promulgated the storage prohibition in order to prevent waste handlers from storing hazardous waste in lieu of proper treatment (§268.50). EPA forbids the storage of waste subject to a treatment standard unless the waste is being stored to accumulate such quantities as are necessary to facilitate proper recycling, treatment, or disposal. During the first year of storage, EPA bears the burden of proving that the waste handler is storing in order to avoid meeting treatment standards rather than to facilitate legitimate recycling, treatment, or disposal. There is no strict time limit on legitimate waste storage; however, after the first year of storage, the burden of proof for showing that waste is indeed being legally accumulated to facilitate proper future management shifts from EPA to the waste handler.

Generators accumulating waste on site in accordance with §262.34 and transporters storing waste at a transfer facility for 10 days or less are exempt from the storage prohibition. The storage prohibition also does not apply to wastes which qualify for an exemption from a treatment standard such as a case-by-case extension in §268.5, a no-migration petition in §268.6, a national capacity variance, or to wastes that were placed in storage prior to the effective date of a prohibition on land disposal.

DILUTION PROHIBITION

EPA generally prohibits dilution of wastes as a substitute for appropriate treatment (§268.3). For example, a waste handler may not, in most cases, achieve compliance with a numeric treatment standard by simply mixing hazardous waste with another material that fails to reduce the mobility or toxicity of the hazardous constituents in the waste. Similarly, EPA may consider waste to be impermissibly diluted when a waste handler treats with an inappropriate technology. For example, it is often impermissible to incinerate metal-bearing, inorganic wastes because incineration fails to destroy or immobilize the hazardous metal constituents.

There are, however, certain cases where EPA permits dilution. Dilution is inherent in some types of legitimate waste handling, such as the aggregation of similar wastes to facilitate subsequent treatment. As a general rule, if aggregated wastes are all legitimately amenable to the same treatment, the aggregation step does not constitute impermissible dilution. In addition, waste handlers may dilute certain characteristic wastes that are managed in Clean Water Act-regulated treatment systems (§268.3(b)). As well, certain characteristic wastes may be diluted to render them nonhazardous before disposal in a deep injection well regulated under the Safe Drinking Water Act (§268.1(c)(3)). Table 1 may be used to determine if a particular waste is subject to a prohibition against dilution when handled in a particular manner.

TABLE 1: SUMMARY TABLE: WASTES SUBJECT TO DILUTION PROHIBITION

Type of Waste	Yes	No
Characteristic Wastes Managed in Clean Water Act-Regulated Treatment Systems (§268.3(b))		✓
Characteristic Wastes Disposed of in Safe Drinking Water Act Underground Injection Control Wells (§268.1(c)(3))		✓
Wastes Subject to a National Capacity Variance (§3004(h)(2))		✓
Wastes Disposed of in a Unit With a No-Migration Variance (§268.6)		✓
Wastes Subject to a Case-by-Case Extension to an Effective Date (§268.5)		✓
Newly Identified or Listed Wastes for Which EPA Has Not Yet Established a Treatment Standard (§268.1(e)(3))		✓
Wastes that Meet All Applicable Treatment Standards and Prohibition Levels		✓
Metal-Bearing Hazardous Wastes That Are Incinerated (§268.3(c))	✓	

Waste Managed in a Corrective Action Management Unit (CAMU) or Temporary Unit (TU) [1]		✓
Wastes from Conditionally Exempt Small Quantity Generators Regulated Under §261.5 [2] (§268.1(e)(1))		✓
Farmers Disposing of Waste On Their Own Land Under §262.70 [2] (§268.1(e)(2))		✓

[1] For more information about these provisions, see the module entitled RCRA Corrective Action.

[2] For more information about these provisions, see the module entitled Generators.

2.8 TRACKING AND RECORDKEEPING REQUIREMENTS

EPA requires generators and TSDFs managing wastes that are subject to LDR (i.e., restricted wastes) to meet certain notification, certification, waste analysis, and recordkeeping requirements pursuant to §268.7. Much like a hazardous waste manifest, the LDR notification and certification paperwork helps hazardous waste handlers and EPA enforcers ensure that wastes are properly managed. A notification accompanies the initial shipment of each waste that is subject to LDR and includes such information as the waste code(s), the hazardous constituents present in the waste, and waste analysis data. EPA requires subsequent notification only when the waste or the receiving facility changes. Additionally, if a waste can be land disposed without further treatment, a certification to that effect must accompany the notification. EPA requires waste handlers to retain such paperwork in order to track wastes that are subject to LDR and to ensure that those wastes receive proper treatment prior to disposal. Section 268.7(a) contains the tracking requirements for generators, §268.7(b) specifies the requirements for treatment facilities, §268.7(c) contains the regulations applicable to disposal facilities, §268.7(d) contains special notification and certification requirements that apply to hazardous debris, and §268.7(e) contains special notification requirements for contaminated soil.

GENERATORS

Generators must determine if their hazardous waste is subject to LDR at the point of generation. They may make this determination by testing or applying knowledge. If a waste is subject to LDR and does not meet applicable treatment standards, generators must notify the treatment facility in writing (§268.7(a)(2)). This notice accompanies the manifest and must include the following information:

- EPA hazardous waste code(s)
- identification of the waste as a wastewater or nonwastewater
- manifest number associated with the waste shipment
- waste analysis data (if available)
- for characteristic wastes, any additional hazardous constituents present
- when hazardous debris is to be treated by an alternative technology in §268.45, a statement to that effect and the contaminants subject to treatment
- for contaminated soil, a list of the constituents subject to treatment and a statement that the soil does or does not meet LDR standards.

If a generator's waste already meets applicable treatment standards, the generator, in accordance with §268.7(a)(3), must submit a signed certification stating that the waste meets the applicable treatment standards. This certification accompanies a copy of the notification statement described above.

If a generator's waste qualifies for an exemption from a treatment standard, such as a national capacity variance, case-by-case extension, or no-migration exemption, the generator must submit to the disposal facility a notification similar to that given in §268.7(a)(2), except that it must also identify the date that the waste will become subject to LDR prohibitions (§268.7(a)(4)).

Generators may treat hazardous waste in accumulation tanks, containers, or containment buildings provided the units are in compliance with certain standards applicable to TSDFs (§262.34). EPA believes that generators should have the same recordkeeping and documentation responsibilities that apply to TSDFs when treating wastes to meet LDR treatment standards. Therefore, §268.7(a)(5) requires generators to prepare a waste analysis plan when treating wastes to meet LDR. The waste analysis plans must justify the frequency of testing based on a detailed analysis of a representative sample of the waste. The plan must contain all information necessary for proper treatment of the waste in accordance with Part 268, and must be retained in the facility's records (55 FR 22670; June 1, 1990). Generators who are conducting partial treatment, but not treating to meet treatment standards are not required to have a waste analysis plan.

TREATMENT FACILITIES

The tracking and recordkeeping requirements that apply to treatment facilities are found in §268.7(b). EPA requires hazardous waste treaters to test treated waste to ensure that all applicable treatment standards are met. The TSDF must perform these tests as specified in its waste analysis plan (all TSDFs must have plans under §264/265.13). If a facility ships treated waste off site for disposal, a notification similar to the generator's notice must accompany the initial shipment of the waste to the disposal facility. The treater's notice must include relevant waste codes, additional hazardous constituents present, manifest information, and waste analysis data (§268.7(b)(3)). The treater must also include a certification that the shipment of waste meets treatment standards (§268.7(b)(4)). If the waste or a residue of the waste will be sent for further treatment or storage at another facility, the treater must comply with the notification and certification requirements for a generator.

LAND DISPOSAL FACILITIES

Section 268.7(c) contains the paperwork requirements that apply to the final link in the cradle-to-grave management of hazardous waste, the land disposal facilities. Hazardous waste disposers must ensure that incoming wastes or residues meet the applicable treatment standards by testing the waste in accordance with their facility's waste analysis plan. Additionally, disposers must maintain records on site of all notifications and certifications received from generators and treatment facilities.

SPECIAL REQUIREMENTS FOR TREATED DEBRIS

Generators or treaters of hazardous debris who claim that their hazardous debris is excluded from the definition of hazardous waste in §261.3(f) are required to comply with certain notification and certification requirements (§268.7(d)). Since these wastes are no longer hazardous, the paperwork will not be sent to the disposal facility. Instead, relevant notices and certifications are submitted to EPA and retained on site by the original generator or treater on a one-time basis.

2.9 CHARACTERISTIC HAZARDOUS WASTES

Just like listed wastes, restricted characteristic wastes must also meet treatment standards before they are eligible for land disposal. Since the land disposal restrictions attach at the point of generation, waste handlers cannot circumvent treatment standards applicable to characteristic wastes by simply removing the characteristic. Once a waste handler both decharacterizes and treats the waste to meet the treatment standard that applied at the point of generation, however, the waste may be land disposed in a nonhazardous, RCRA Subtitle D landfill.

TREATMENT STANDARDS

EPA established special requirements for wastes that exhibit a characteristic (§268.9). As a general principle, a hazardous waste must meet all applicable treatment standards before land disposal. For purposes of LDR, a generator with a listed hazardous waste must determine if the waste also exhibits any hazardous waste characteristics (§262.11(c)). If a listed waste also exhibits a characteristic of hazardous waste, the waste must meet the treatment standard for both waste codes. An exception occurs, however, when the treatment standard for the listed waste specifically includes a standard for the constituent that causes the waste to exhibit the characteristic. In this case, compliance with the treatment standard for the listed waste will satisfy both requirements, as the standard for the listed waste will operate in lieu of the treatment standard for the characteristic waste code.

PAPERWORK REQUIREMENTS

While characteristic wastes are subject to the standard notification requirements in §268.7, EPA subjects wastes from which the characteristic has been removed to special provisions. When these wastes meet treatment standards and no longer exhibit any characteristic, LDR notification and certification paperwork need not accompany the shipment to a Subtitle D facility. Instead, §268.9(d) requires the waste handler to file a one-time notice and certification with the implementing agency and maintain a copy on site. However, when the RCRA Burden Reduction rule is finalized, this requirement may change. Subsequent shipments of similar waste do not require additional notice except on an annual basis, or if the process or recipient facility changes.

DILUTION OF CHARACTERISTIC WASTES AND TREATMENT OF UNDERLYING HAZARDOUS CONSTITUENTS

When EPA first promulgated treatment standards for characteristic wastes, the Agency initially determined that removal of the hazardous waste characteristic alone would adequately protect human health and the environment. Thus, the treatment standards for these wastes appeared as the specified technology, "DEACT," or deactivation. While Part 268, Appendix VI, recommends particular methods of treatment to accomplish deactivation, simple dilution with soil or water was an acceptable means to achieve compliance. Dilution of this kind was not considered impermissible per §268.3, since it was performed as part of a specified technology.

However, in the case, *Chemical Waste Management, Inc., et al. v. EPA*, the plaintiffs won a judgment against the Agency alleging, among other things, that deactivation via dilution failed to meet the statutory mandates of RCRA §3004(m) because dilution does not reduce the mobility or toxicity of the hazardous constituents present in the wastes. On September 25, 1992, the DC Circuit Court of Appeals immediately vacated the treatment standards for ignitable (D001) and corrosive (D002) wastes and remanded the treatment standards applicable to many other characteristic wastes.

In response to the court decision, EPA published revised treatment standards for D001 and D002 wastes on May 24, 1993 (58 FR 29860). These revised standards require that certain ignitable and corrosive wastes not only be deactivated to remove the hazardous characteristic, but that they also be legitimately treated to meet numeric concentration levels for any constituents also present in the wastes above the UTS levels. These constituents are known as "underlying hazardous constituents" because they require treatment to meet LDR standards, but nonetheless do not cause the waste to exhibit a characteristic.

On September 19, 1994, when EPA promulgated treatment standards for the newly identified toxicity characteristic (TC) organic wastes (D018-D043) and revised the standards for some previously restricted characteristic wastes (D012-D017), the Agency also required treatment for underlying hazardous constituents beyond that necessary for removal of the characteristic. When EPA promulgated revised treatment standards for metal wastes on May 26, 1998, the new metal standards also required waste handlers to treat for underlying hazardous constituents (63 FR 28556). The creation of the UTS in §268.48 gave the Agency an easy source for the list of constituents and appropriate treatment levels. Wastes requiring treatment for underlying hazardous constituents must meet the numeric treatment levels enumerated in the UTS to be eligible for land disposal. Wastes subject to treatment for underlying hazardous constituents are easily identified since their treatment standards in §268.40 require that they comply with the characteristic level "and meet §268.48 standards."

Part of the settlement agreement and consent decree with Chemical Waste Management, Inc. et al., required EPA to ensure that waste handlers effectively treat characteristic wastewaters that are managed in certain CWA and SDWA systems; to merely decharacterize or dilute these wastes would not satisfy Congress's mandate to substantially diminish the toxicity of hazardous waste. As a result, on April 8, 1996 (61 FR 15566), EPA finalized treatment standards for characteristic wastes injected into deep SDWA wells, managed in non-hazardous surface impoundments prior to CWA discharge, or discharged to land following CWA-equivalent management. Specifically, these regulations would have required that such wastes undergo RCRA-equivalent treatment not only to remove the characteristic, but also to destroy or immobilize underlying hazardous constituents.

Despite the finalization of these treatment standards for characteristic wastewaters managed in certain CWA and SDWA-systems, these provisions were immediately altered by the Land Disposal Program Flexibility Act of 1996. The new law removed the requirement that characteristic wastewaters be treated to remove, destroy, or immobilize hazardous constituents. As a result, characteristic wastewaters managed in certain CWA or SDWA-systems need only be decharacterized before land disposal, and dilution may be used to satisfy this requirement. Consequently, the Agency published, in the same Federal Register that contained the new treatment standards, a notice to rescind those regulations and require only decharacterization for characteristic wastewaters in accordance with the provisions of the new Land Disposal Program Flexibility Act (61 FR 15661). See additional discussion of the statutorily mandated study of decharacterized waste disposed of in surface impoundments in Section 4 of this module, entitled "Regulatory Developments."

3. SPECIAL ISSUES

The following three points discuss LDR issues of special note or concern.

3.1 POINT OF GENERATION

Generators are required to classify their solid wastes as soon as they are subject to regulation in order to ensure that hazardous wastes will always be safely managed. Since LDR applies additional limits to the ways in which waste may be managed, it is also necessary to immediately determine if a hazardous waste is subject to LDR. Generators must, therefore, fully characterize their wastes at the point of generation to determine if their hazardous waste is subject to LDR (§262.11). If a waste is restricted at the point of generation, all Part 268 requirements continue to apply to the waste, even if it is subsequently de-characterized or excluded from the definition of hazardous or solid waste.

3.2 DIOXIN-CONTAINING WASTE

EPA bases the §268.40 treatment standards for dioxin-containing wastes on a BDAT of incineration. While any technology short of dilution is permissible for achieving the required contaminant levels, only incineration has been able to achieve them. Currently, no facility in the United States is permitted to burn dioxin-containing wastes. In the interim, these listed wastes must be exported or stored until treatment capacity becomes available.

3.3 LDR APPLICABILITY AND REMEDIATION WASTES

In order to ensure that site cleanups and remediation are conducted in a timely and cost-effective fashion, EPA has designed special standards for the management of certain remediation wastes. In the February 16, 1993, Federal Register (58 FR 8658), EPA promulgated regulations on the use of corrective action management units (CAMUs) and temporary units (TUs) to manage remediation waste generated during a site cleanup. Additionally, on November 30, 1998, EPA finalized standards for a new type of unit, called a staging pile, into which a waste handler can place solid, non-flowing remediation waste (63 FR 65874; §264.554).

To facilitate the cleanup process, these regulations effectively waive the requirement that wastes managed in staging piles, CAMUs, TUs meet LDR treatment standards prior to storage or disposal on the land. However, EPA established a new framework for the treatment of wastes placed in CAMUs (67 FR 2962; January 22, 2002). Under this framework, principal hazardous constituents (PHCs) identified in the waste must meet either minimum national treatment standards adapted from the LDR alternative soil standards (see Section 2.5 Alternative Treatment Standards) or, in special circumstances, site-specific treatment standards (See also the module entitled RCRA Corrective Action).

4. REGULATORY DEVELOPMENTS

With the completion of the "Thirds," EPA had addressed all hazardous wastes that were identified or listed before November 8, 1984. Similarly, with the completion of Phase IV, EPA addressed all hazardous wastes that were newly-identified or listed after November 8, 1984. Since EPA has fulfilled its requirements to establish treatment standards for all hazardous wastes through the Thirds and the Phases (as required by the Statute), in the future, the Agency will propose LDR treatment standards when hazardous wastes are proposed for listing. On November 20, 1995, EPA began this process by proposing LDR treatment standards for petroleum refining process wastes in the same rule that proposed to list such wastes as hazardous (60 FR 57747). The petroleum listings and their LDR treatment standards were finalized August 6, 1998 (63 FR 42110). On November 25, 2003, EPA proposed to list as hazardous waste certain waststreams from the dyes and pigments industry. This listing, as well as LDR treatment standards for constituents in the new listing, were finalized on February 24, 2005 (70 FR 9138) (See Section 4.2, below). Consistent with this approach, all future waste treatment standards will be promulgated in conjunction with the waste listing.

Currently, EPA is considering amending several aspects of the solid waste regulatory scheme.

4.1 BURDEN REDUCTION INITIATIVE

On January 17, 2002, EPA proposed to reduce the recordkeeping and reporting burden imposed by RCRA on the states, the public, and the regulated community to meet the federal government-wide goal established by the Paperwork Reduction Act (PRA) (67 FR 2518). When finalized, the Burden Reduction Initiative will reduce the reporting requirements for generators and TSDFs by eliminating or modifying non-essential paperwork. A few changes to the LDR recordkeeping provisions are likely to be finalized.

4.2 DYES AND PIGMENTS

On February 24, 2005, EPA finalized the Waste from the Production of Dyes and Pigments Listed as Hazardous rule, which listed as hazardous nonwastewaters generated from the production of certain dyes, pigments, and FD&C colorants. This action is mandated by the 1984 Hazardous and Solid Waste Amendments and a consent decree (*EDF v. Browner*, Civil Action No. 89-0598, D.D.C.). This listing sets annual mass loadings for constituents of concern, such that wastes would not be hazardous if the constituents are below the regulatory thresholds. If the wastes meet or exceed the regulatory levels for any constituents of concern, the wastes must be managed as listed hazardous wastes, unless the wastes are either disposed in a landfill unit that meets certain liner design criteria, or treated in a combustion unit as specified in the listing description. This rule also adds five toxic constituents to the list of hazardous constituents that serves as the basis for classifying wastes as hazardous. In addition, this rule establishes Land Disposal Restrictions treatment standards for the wastes, and designates these wastes as hazardous substances subject to CERCLA. The effective date of this rulemaking is August 23, 2005 (70 FR 9138; February 24, 2005).

4.3 MICROENCAPSULATION OF RADIOACTIVE LEAD SOLIDS

EPA anticipates taking action to grant a national determination of equivalent treatment petition at the request of the Department of Energy. Currently, the use of containers is prohibited for the storage of radioactive lead solids before disposal pursuant to §268.42, thus necessitating the segregation and separation of radioactive lead solids from other debris. Containers can be constructed of high density polyethylene (HDPE) to provide a resistant barrier to degradation by the wastes and materials into which it may come into contact after disposal. The use of such containers require revision to current regulation will be required to allow the use of such HDPE containers. EPA intends approval of the equivalent treatment variance to promote faster cleanup of contaminated sites by removing a regulatory distinction between radioactive lead solids and other forms of hazardous debris, reduce worker exposures, and promote further advancement in new technologies for disposal. The use of containers are expected to be less costly than extrusion coatings and, therefore, this action would be cost neutral to cost beneficial to the Department of Energy and other generators of radioactive lead solids (70 FR 27510, 27640; May 16, 2005).

RCRA Training Module

Solid Waste and Emergency Response
(5305W)
EPA530-K-05-014

Introduction to

Land Disposal Units

(40 CFR Parts 264/265, Subparts K, L, M, N)

September 2005

United States
Environmental Protection
Agency

LAND DISPOSAL UNITS

CONTENTS

1. INTRODUCTION

Subtitle C of the Resource Conservation Recovery Act (RCRA) creates a cradle-to-grave management system for hazardous waste to ensure proper treatment, storage, and disposal in a manner protective of human health and the environment. Under RCRA §3004(a), Congress authorized EPA to promulgate regulations establishing design and operating requirements for land disposal units (LDUs). The requirements are intended to minimize pollution resulting from the disposal of hazardous waste in or on the land. RCRA §3004(k) defines land disposal as placement of hazardous waste in any of the following nine types of units:

- landfill
- surface impoundment
- waste pile
- injection well
- land treatment facility.
- salt dome formation
- salt bed formation
- underground mine
- underground cave

EPA has promulgated unit-specific technical standards for four of these LDUs within the treatment, storage, and disposal facility (TSDF) requirements in 40 CFR Part 264/265. This module provides an overview of the requirements for these four LDUs: landfills, surface impoundments, waste piles, and land treatment units. LDUs that do not qualify as one of these units are considered miscellaneous units (see the module entitled Miscellaneous and Other Units for more details).

When you have completed this module, you will be able to summarize the land disposal unit standards and list the relevant statutory and regulatory citations. Specifically, you will be able to:

- cite the statutory and regulatory minimum technological requirements
- summarize the differences between interim status (Part 265) and permitted (Part 264) standards for land disposal units
- find the definition of "surface impoundment" and distinguish surface impoundments from tanks
- describe surface impoundment retrofitting and retrofitting variance procedures
- explain the connection between land disposal unit standards, post-closure, and groundwater monitoring requirements.

Use this list of objectives to check your knowledge of this topic after you complete the training session.

2. REGULATORY SUMMARY

Regulations governing surface impoundments, waste piles, land treatment units, and landfills are codified in Part 264/265, Subparts K through N. The standards for permitted and interim status units address design and operating requirements, including liners and leachate collection and removal systems (LCRS); closure and post-closure requirements; and special standards for ignitable, reactive, and dioxin-containing wastes. In addition to these unit-specific requirements, LDUs managing hazardous waste are subject to the general facility standards found in Subparts A through E in Part 264/265, as well as the appropriate groundwater monitoring, closure and post-closure, and financial assurance requirements.

For each unit discussed, this module addresses five topic areas: design and operation, inspections, response actions, closure and post-closure, and special issues. This format will enable you to compare and contrast the regulations for each unit.

2.1 SURFACE IMPOUNDMENTS

Subpart K in Part 264/265 contains the design and operating standards for surface impoundments used to treat, store, or dispose of hazardous waste. Surface impoundments are very similar to landfills in that both units are either a natural topographic depression, manmade excavation, or diked area formed primarily of earthen materials, such as soil (although the unit may be lined with manmade materials). The units are, however, very different in their use. Surface impoundments are generally used for temporary storage or treatment, whereas a landfill is an area designated for final waste disposal. Therefore, while the design and operating standards are very similar, the closure and post-closure standards differ.

Most of the design, operating, and inspection requirements are very similar for surface impoundments, waste piles, and landfills. The requirements are discussed in detail in this section, with successive sections referring to this section for specifics.

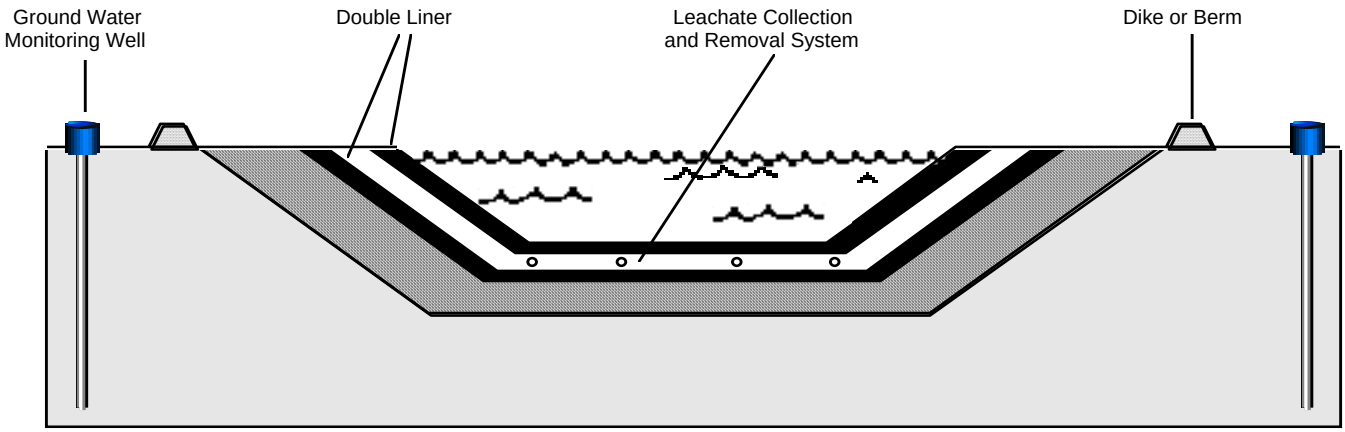
DESIGN AND OPERATION

In developing design and operation requirements for surface impoundments (as well as landfills and waste piles), EPA adopted a regulatory goal of minimizing the formation and migration of leachate to the adjacent subsurface soil, groundwater, and surface water.

These comprehensive technical requirements for surface impoundments are the minimum technological requirements (MTRs) mandated by RCRA §3004(o)(1)(A) and (o)(4). These sections require a double liner, a LCRS, and a leak detection system (§§264.221(c) and 265.221(a)). These MTRs apply to all new units, lateral expansions, and replacement units for which construction (or reuse) commences after July 29, 1992. New, lateral expansion, and replacement units for which construction (or reuse) began between July 15, 1985, and July 29, 1992, were required to have only the double liner and LCRS. Surface impoundments not subject to these MTRs are subject only to single liner requirements (§264.221(a)).

The double liner system consists of a top liner to prevent migration of hazardous constituents into the liner and a composite bottom liner consisting of a synthetic geomembrane and three feet of compacted soil material. The unit must also be equipped with an LCRS, which also serves as the leak detection system. The LCRS, along with the leak detection system drainage layers, must be designed with a bottom slope of at least one percent, be made of materials chemically resistant to the wastes placed in the unit, and be able to remove the liquids at a specified minimum rate. The LCRS itself must be designed to collect liquids in a sump and subsequently pump out those liquids. In addition to the performance and design requirements, the LCRS must be located between the liners immediately above the bottom composite liner, enabling the LCRS to collect the largest amount of leachate, while also representing the most efficient place to identify leaks. These MTRs are depicted in Figure 1 using a cross-section of a surface impoundment.

Figure 1
CROSS-SECTION OF A SURFACE IMPOUNDMENT AND ITS MINIMUM TECHNOLOGICAL REQUIREMENTS



A surface impoundment must also be designed to prevent the flow of liquids over the top of an impoundment (or overtopping) and ensure the structural integrity of any dikes. Also, §264.222 requires that the owner or operator establish a site-specific leachate flow rate, called the action leakage rate (ALR), to indicate when each regulated unit's system is not functioning properly.

None of these technologies will be effective if the impoundment is installed improperly or constructed of inferior materials. To ensure that a surface impoundment meets all technical criteria, EPA requires a construction quality assurance (CQA) program. The CQA program requires a CQA plan that identifies how construction materials and their installation will be monitored and tested and how the results will be documented (§264.19). The CQA program is developed and implemented under the direction of a registered professional engineer, who must also certify that the CQA plan has been successfully carried out and that the unit meets all specifications before any waste is received.

INSPECTION AND RESPONSE ACTIONS

In addition to the general inspection requirements found in §264/265.15, there are two types of specific inspections required at LDUs. The first inspection requirement addresses the design and structural integrity of the unit (§264/265.226). The owner and operator must inspect liners and covers for any problems after construction or installation and continue inspections weekly and after storms to monitor for evidence of deterioration, malfunctions, improper operation of overtopping systems, sudden drops in the level of the impoundment contents, and severe erosions of dikes and other containment devices.

Per the second inspection requirement, owners and operators must monitor leak detection sumps at least weekly to measure the amount of liquid in the sump and determine whether the ALR has been exceeded. This verifies both liner integrity and leachate pump efficiency. If a leak exceeds the ALR, the owner and operator must notify the Agency and respond in accordance with the response action plan (§264/265.223).

Surface impoundments must also comply with two types of response actions for the design and performance of the unit. The response action for the performance of the unit is determined by the terms of the response action plan, triggered when the ALR has been exceeded (§264/265.223). If the action leakage rate has been exceeded, the owner and operator must notify the Regional Administrator or authorized state; determine what short-term actions must be taken (e.g., shut down of the facility for repairs); determine the location, size, and cause of any leak; and send the assessments to the Region or authorized state.

There are also emergency repair provisions for unit design failure at permitted facilities (§264.227). If there is an indication of a failure of the containment system (e.g., a sudden drop in the level of the contents not attributable to changes in the flow in or out of the impoundment), the surface impoundment must be removed from service. When this occurs, the owner and operator must follow the procedures in the contingency plan, including any necessary emergency repairs.

CLOSURE

Owners and operators can use one of two options to close a hazardous waste surface impoundment. The first option, called clean closure, requires the owner and operator to remove or decontaminate all wastes and unit components at closure (§264/265.228(a)(1)). If the unit cannot be clean-closed, then the owner and operator must employ the second alternative. Under this approach, wastes are left in place and stabilized, free liquids are removed, and a cap or cover is placed on top of the waste. Since surface impoundments are generally used for storage, the second option is equivalent to closing as a landfill and requires the owner or operator to take certain precautions for a set time period after closure, known as post-closure care (§264/265.228(a)(2) and (b)).

SPECIAL REQUIREMENTS FOR CERTAIN WASTES

RCRA places special requirements on surface impoundments that handle ignitable or reactive wastes because these wastes require continuous protection from conditions that could cause them to ignite or react (§264/265.229).

Additionally, §264/265.230 prohibits the placement of incompatible waste or materials, as described in Appendix V in Part 264/265, in the same surface impoundment unless certain precautions are taken.

Furthermore, if an owner or operator of a surface impoundment plans to manage dioxin-containing waste (i.e., F020, F021, F022, F023, F026, and F027), he or she must employ a special management plan approved by the Regional Administrator or authorized state (§264.231). These wastes can only be disposed of in a permitted surface impoundment.

SURFACE IMPOUNDMENT RETROFITTING

Owners and operators of existing surface impoundments that become subject to RCRA as the result of a new hazardous waste listing or characteristic must retrofit or cease receipt of hazardous waste and begin the closure process within four years of the promulgation of the listing or characteristic. For example, owners and operators of surface impoundments that became subject to RCRA as the result of the promulgation of the Toxicity Characteristic on March 29, 1990, were required to retrofit those units to meet the minimum technological requirements or cease receipt of hazardous waste and begin the closure process by March 29, 1994 (55 FR 11798, 11835; March 29, 1990). However, surface impoundments that do not meet minimum technological requirements may continue to receive restricted wastes if the Regional Administrator or authorized state grants the unit a waiver under §3005(j) of RCRA.

SURFACE IMPOUNDMENT VS. TANK

The definitions of surface impoundment and tank are very similar and tend to create confusion. The major difference in the two definitions is what provides the structural support to the unit. Surface impoundments are supported by earthen materials, while tanks are supported by non-earthen materials (e.g., wood, concrete, steel, plastic). In determining whether a unit is supported by earthen or non-earthen material, it should be evaluated as if it were free-standing and filled to its design capacity. If the unit can maintain its structural integrity, it is considered a tank. If the unit cannot retain its structural integrity, it is considered a surface impoundment.

2.2 WASTE PILES

Regulations governing the management of hazardous waste in waste piles are found in Part 264/265, Subpart L. Waste piles, which are essentially noncontainerized piles of solid, nonflowing hazardous waste, are temporary units used for storage or treatment only (§260.10). Because waste piles are temporary units are not intended for final disposal of wastes, Subpart L does not contain post-closure care regulations for waste piles that are closed with waste in place;

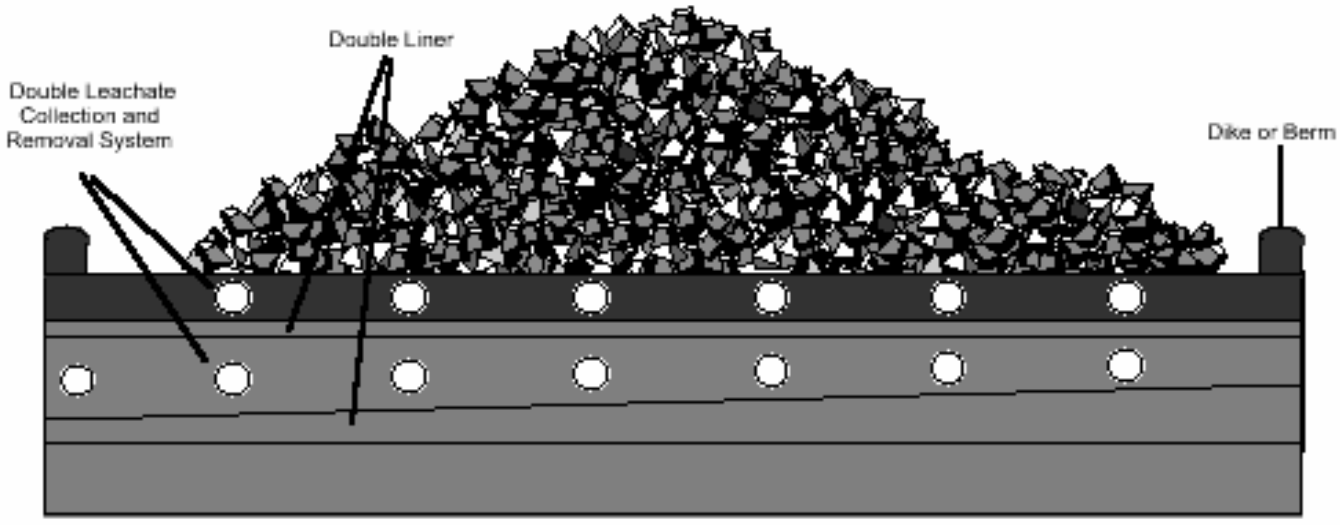
such units however, are considered permanent or disposal units and are subject to post-closure care since they are closing as landfills (see Section 2.4).

Owners and operators of permitted waste piles that meet special requirements are subject to reduced regulation. Specifically, the waste pile must be located inside or under a structure and not receive free liquid, protected from surface water run-on, designed and operated to control dispersal of waste, and managed to prevent the generation of leachate. If these standards are met, the owner and operator of the permitted waste pile are exempt from groundwater monitoring requirements, as well as the design and operation requirements for waste piles (§264.250(c)).

DESIGN AND OPERATION

Waste piles are subject to nearly the same MTRs as surface impoundments. Specifically, new units, lateral expansions, and replacement units require a double liner and LCRS (§§264.251(c) and 265.254). In addition, waste piles, with certain exceptions, require a second leachate collection and removal system above the top liner. Figure 2 depicts these requirements. If the permitted waste pile is not subject to MTR (i.e., a unit, lateral expansion, or replacement for which construction commenced before July 29, 1992), then the unit is subject to a single liner and basic LCRS requirements. Interim status waste piles that are not subject to MTR are subject only to liner, run-on, and runoff controls if leachate or runoff is found to be a hazardous waste.

Figure 2
CROSS-SECTION OF A SURFACE IMPOUNDMENT AND ITS MINIMUM TECHNOLOGICAL REQUIREMENTS



provision only requires the owner and operator of a waste pile meeting MTR to record the amount of liquids removed from the leak detection system sump at least once a week (§265.260). Note that waste piles are not subject to the emergency repair provisions for surface impoundments.

CLOSURE

Since waste piles are storage units, as opposed to disposal units, all waste residues and contaminated subsoils and equipment must be removed or decontaminated at closure (§264/265.258(a)). This requirement is identical to the clean closure requirements for a surface impoundment. If the owner or operator removes or decontaminates all waste residues and makes all reasonable efforts to remove or decontaminate all structures and soils and finds that some contamination remains, the waste pile will then be subject to the closure requirements for landfills, including post-closure care (§264/265.258(b)).

SPECIAL REQUIREMENTS FOR CERTAIN WASTES

Waste piles are subject to the same specialized standards for ignitable, reactive, incompatible, and dioxin-containing waste as surface impoundments. These requirements are discussed in Section 2.1.

WASTE PILE VS. CONTAINMENT BUILDING

Containment buildings, sometimes characterized as "indoor waste piles," are units used to hold noncontainerized piles of hazardous waste. The difference between waste piles and containment buildings, from a regulatory standpoint, is that containment buildings are not land disposal units. For this reason, containment buildings are designed with a containment system rather than a liner and leak detection system (Part 264/265, Subpart DD). The module entitled Containment Buildings provides more information about the standards that apply to containment buildings.

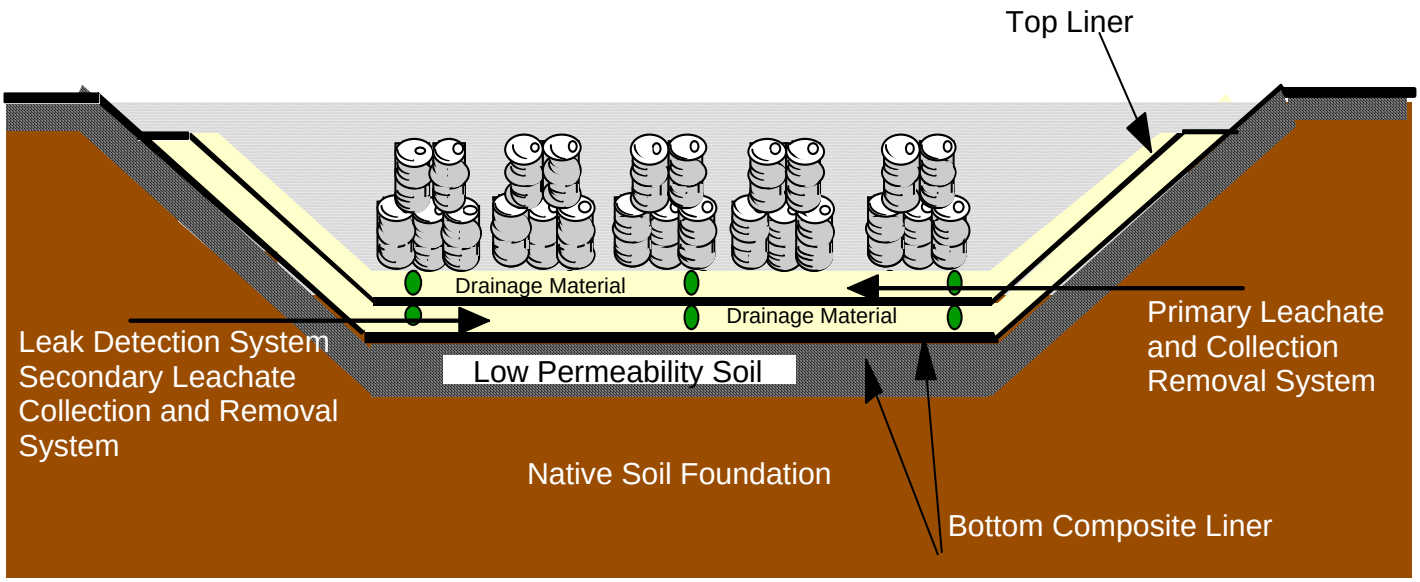
2.3 LANDFILLS

Since landfills are used as final disposal sites for a large portion of the nation's hazardous waste, it is critical that they are monitored during their entire active life, including closure, and the post-closure period. The regulations concerning hazardous waste landfills are codified in Part 264/265, Subpart N.

DESIGN AND OPERATION

Landfills are subject to virtually the same MTRs as surface impoundments and waste piles. They must have a double-liner, LCRSs, and leak detection (§264/265.301), and an ALR (§264/265.302). Like waste piles, landfills require a second LCRS that is above the top liner. Figure 3 illustrates the MTRs of landfills. In addition, landfills must have stormwater run-on and runoff controls to prevent migration of hazardous constituents for at least a 25-year storm and a cover to prevent wind dispersal.

Figure 3
CROSS-SECTION OF A LANDFILL AND ITS MINIMUM TECHNOLOGICAL REQUIREMENTS



INSPECTION AND RESPONSE ACTIONS

Once again, the inspection and response action plans are almost identical to the requirements for surface impoundments, including a response action plan if the ALR is exceeded (§§264.304 and 265.303) and a CQA program (§264/265.19). In addition, the owner and operator of a hazardous waste landfill must perform monitoring and inspections (§§264.303 and 265.304). As with surface impoundments and waste piles, these requirements ensure that the unit is maintained in good working condition and that any problems are promptly detected.

CLOSURE

Since landfills typically serve as permanent disposal sites, the closure and post-closure requirements for landfills are somewhat different from those for other land-based units. One example is the requirement for a final cover over the landfill that can provide long-term minimization of liquid migration through the closed landfill, promote drainage, accommodate settling, and function with a minimum amount of maintenance (§264/265.310(a)). After closure, the owner or operator must comply with the post-closure requirements in §§264/265.117 through 264/265.120 covering such actions as monitoring and maintenance (see the module entitled Closure and Post-Closure). In addition, the owner and operator must maintain the final cover, leak detection system, and groundwater monitoring system, as well as prevent run-on and runoff from damaging the final cover and protect the surveyed benchmarks (i.e., location and characteristics) of the landfill.

SPECIAL REQUIREMENTS FOR CERTAIN WASTES

Like surface impoundments and waste piles, landfills are subject to certain restrictions for the management of ignitable, reactive, incompatible, and dioxin-containing wastes. Unlike other units, though, the placement of bulk or noncontainerized liquid hazardous waste or hazardous waste containing free liquids in any landfill is prohibited (§264/265.314(b)). The placement of nonhazardous liquids in a landfill is also essentially prohibited (§§264.314(e) and 265.314(f)). There are only certain situations when containers holding free liquids can be placed in a landfill (e.g., small containers such as ampules, containers that are products such as batteries, or lab packs) (§§264.314(d) and 265.314(c)). If sorbents are used to treat hazardous wastes so that the waste no longer contains free liquids, the owner and operator must use nonbiodegradable sorbents.

SPECIAL REQUIREMENTS FOR CERTAIN CONTAINERS

To prevent significant voids that could cause collapse of final covers when containers erode, and to maintain and extend available capacity in hazardous waste landfills, containers placed in a landfill must be either at least 90 percent full or crushed, shredded, or in some other way reduced in volume, unless the containers are very small, such as ampules (§264/265.315).

Finally, there are special standards for lab packs or overpacked drums being placed in a landfill (§264/265.316). Lab packs generally contain small containers of a wide variety of hazardous wastes in relatively small volumes that are packed in sorbent material to prevent leaking. This sorbent material must be nonbiodegradable.

2.4 LAND TREATMENT UNITS

While surface impoundments, waste piles, and landfills share many regulatory standards, land treatment units (LTUs) are significantly different both in purpose and in management. Land treatment involves the application of waste on the soil surface or the incorporation of waste into the upper layers of the soil in order to degrade, transform, or immobilize hazardous constituents present in hazardous waste. Essentially, the waste is treated within the matrix of the surface soil, whereas the major goal of the other units is to prevent migration to the surface soil. Specifically, the waste must be placed only in the unsaturated zone, the portion of the surface soil above the water table (or the highest point of the groundwater flow). Based on the proximity to the groundwater, the success of land treatment is highly dependent on the operational management of the unit.

Because the goal of land treatment is to let the soil microbes and sunlight degrade the hazardous waste, the design and operating standards are significantly different from those imposed on the three types of units previously discussed. Land treatment units generally do not use impermeable liners to contain wastes. Instead, units rely on the physical, chemical, and biological processes occurring in the topsoil layers. In a sense, these units can be viewed as an open system.

Maintenance of proper soil pH, careful management of waste application rate, and control of surface water runoff are all key to the operation of a land treatment unit. The regulations for hazardous waste land treatment units are in Part 264/265, Subpart M.

Because placement of hazardous waste in a land treatment unit is considered land disposal, land disposal restrictions (LDR) standards must be considered. If the hazardous waste does not meet the applicable treatment standard prior to placement in the land treatment unit, the unit owner or operator must obtain a no-migration variance before applying any hazardous waste to the unit, per §268.6. (See the Land Disposal Restrictions module for more details concerning the LDR standards and no-migration variances.)

DESIGN AND OPERATION

Owners and operators of land treatment units must devise a program and demonstrate its effectiveness given the design of the unit and characteristics of the area. In addition, the regulations require specific operating requirements to be met in the treatment program. The following discussion details these requirements.

Treatment Program and Demonstration

The requirements outlined for the treatment program, including design and operating criteria and unsaturated zone monitoring, stem from a treatment demonstration. The purpose of the treatment demonstration is to show that hazardous constituents in the waste can be completely degraded or immobilized in the treatment unit. A treatment demonstration may involve field testing on a sample soil plot or laboratory testing. The Regional Administrator or authorized state uses information provided by the treatment demonstration to set permit standards. Interim status units are not required to establish a treatment program because the interim status regulations are self-implementing. Owners and operators can only place hazardous waste in the LTU, however, if the waste will be rendered nonhazardous or less hazardous (§265.272(a)).

During the treatment demonstration, the owner and operator must establish the following parameters:

- Specify the wastes that may be handled at the unit. In general, land treatment is confined to wastes that are primarily organic and that can be greatly reduced in volume by physical, chemical, and biological decomposition in surface soils. The owner and operator must be able to account for smaller fractions of heavy metals and persistent organic compounds by immobilizing those constituents (§264.271(a)(1)).

- Formulate a set of operating measures. The LTU must be operated in a manner that will maximize degradation, transformation, and immobilization of hazardous waste constituents. The specifics of the operation are discussed in the following section of this module (§264.271(a)(2)).

- Establish unsaturated zone monitoring. The purpose of this program is to make sure that treatment is occurring within the treatment zone and that all hazardous constituents are being adequately treated. The information provided from the monitoring can help the

owner and operator "fine tune" the treatment process to maximize the success of the treatment. Unsaturated zone monitoring involves soil monitoring (e.g., obtaining soil samples) immediately below the treatment zone (§264.271(a)(3)).

- Define the treatment zone. This zone comprises the horizontal and vertical dimensions of the unsaturated zone in which the owner and operator intend to perform the actual treatment. The zone can be no deeper than 1.5 meters (5 feet) and the bottom of the zone must be at least one meter (3.2 feet) above the seasonal high water table (§264.271(c)).

Operation

Basic design and operating requirements are outlined in §§264.273 and 265.272. These sections require the Regional Administrator or authorized state to specify certain parameters in the facility permit:

- rate and method of waste application
- measures to control soil pH
- measures to enhance microbial and chemical reactions
- measures to control the moisture content of the treatment zone.

In addition, land treatment units are subject to requirements for stormwater run-on and runoff controls. Management to control wind dispersal and weekly inspections are also required.

Food Chain Crops

In some cases, the owner and operator may grow food-chain crops on a land treatment unit (§264/265.276). The Agency believes that this can be done safely if certain conditions are met that require the owner or operator to demonstrate that hazardous constituents are not present in the crop in abnormally high concentrations. Additionally, if cadmium is present in the unit, the owner and operator must comply with additional management standards specified in §264.276(b) and (c).

INSPECTIONS AND RESPONSE ACTIONS

Although there are no requirements to inspect the unit, the owner and operator must maintain unsaturated zone monitoring to assure that the unit is meeting its performance standards (§264/265.278).

As discussed earlier, the purpose of unsaturated zone monitoring is to provide feedback on the success of treatment in the treatment zone and to determine if hazardous constituents are migrating out of the treatment zone (i.e., the monitoring program must be designed to determine the presence of hazardous constituents below the treatment zone). Generally, this means that the owner and operator would monitor for the most stable hazardous constituents found in the wastes placed in or on the treatment zone. However, unsaturated zone monitoring is not a substitute for groundwater monitoring. Both are required for land treatment units.

To perform unsaturated zone monitoring, the owner and operator must first establish which constituents must be monitored and the background levels of those constituents in the soil. The frequency of the monitoring is based on the elements of the operation of the LTU, such as the frequency, timing, and rate of application of the waste. Once the samples have been taken, the owner and operator must determine whether there is a statistically significant change over the background values (i.e., the natural constituent levels in the soil) for any hazardous constituent. If there is a statistically significant increase in the hazardous constituents of concern, the owner and operator must notify the Regional Administrator or authorized state within seven days, and submit a permit modification within 90 days to change the operating practices at the facility to sufficiently treat hazardous constituents within the treatment zone.

CLOSURE

When a land treatment unit is being closed, the owner and operator must maintain all operating parameters to continue the treatment processes, as well as maintain run-on and runoff controls and unsaturated zone monitoring. The major element of the closure procedure is placing a vegetative cover over the closing unit that is capable of maintaining growth without extensive maintenance. At the completion of closure, the owner or operator may submit the closure certification by an independent qualified soil scientist in lieu of an independent registered professional engineer. Closure and post-closure requirements are waived when the hazardous constituents in the treatment zone no longer exceed background levels.

SPECIAL REQUIREMENTS FOR CERTAIN WASTES

Like other LDUs, land treatment units are subject to limitations regarding ignitable, reactive, incompatible, and dioxin-containing wastes (§§264/265.281, 264/265.282 and 264.283).